AUTOMOBILE NUMBER

SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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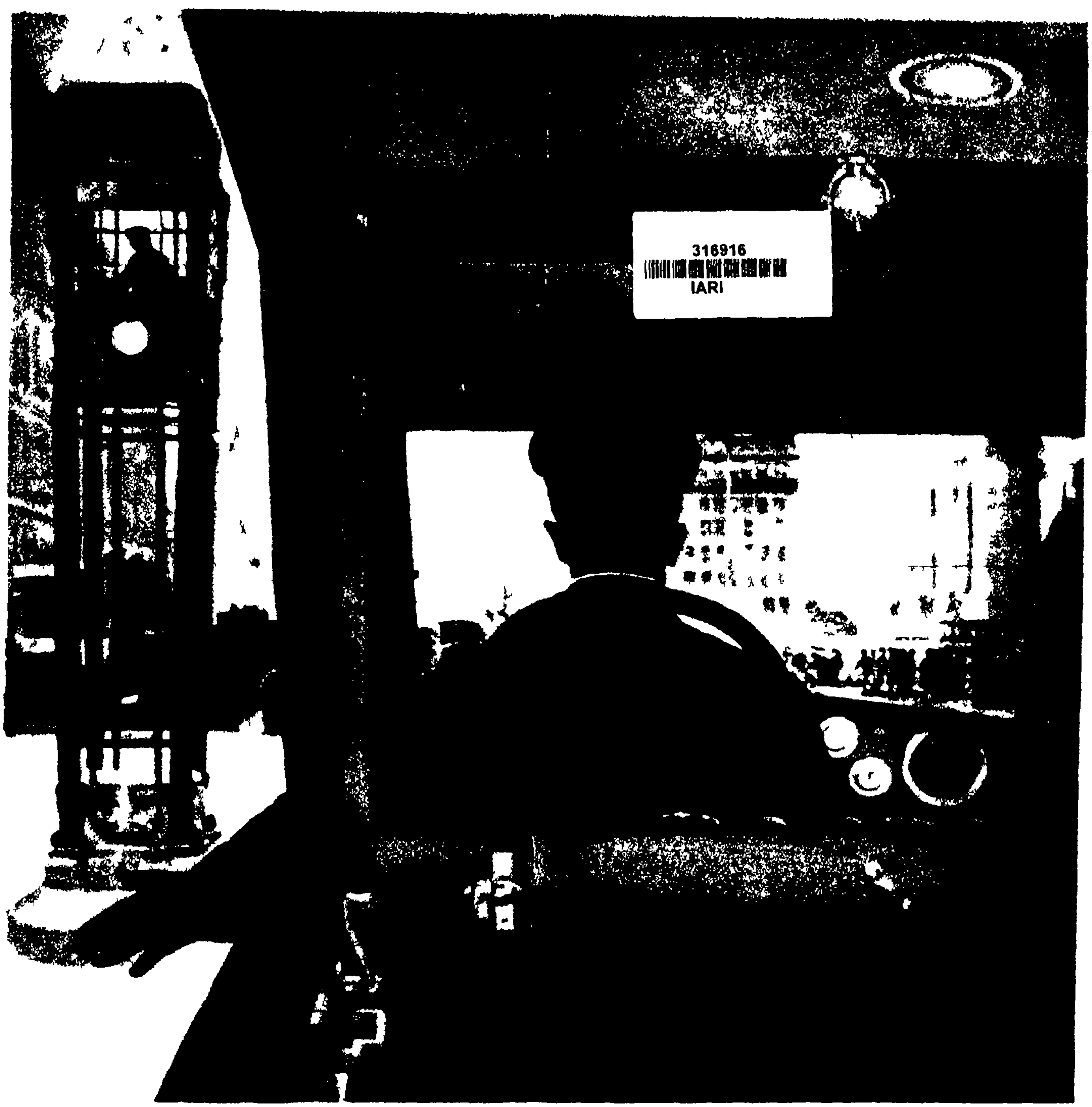

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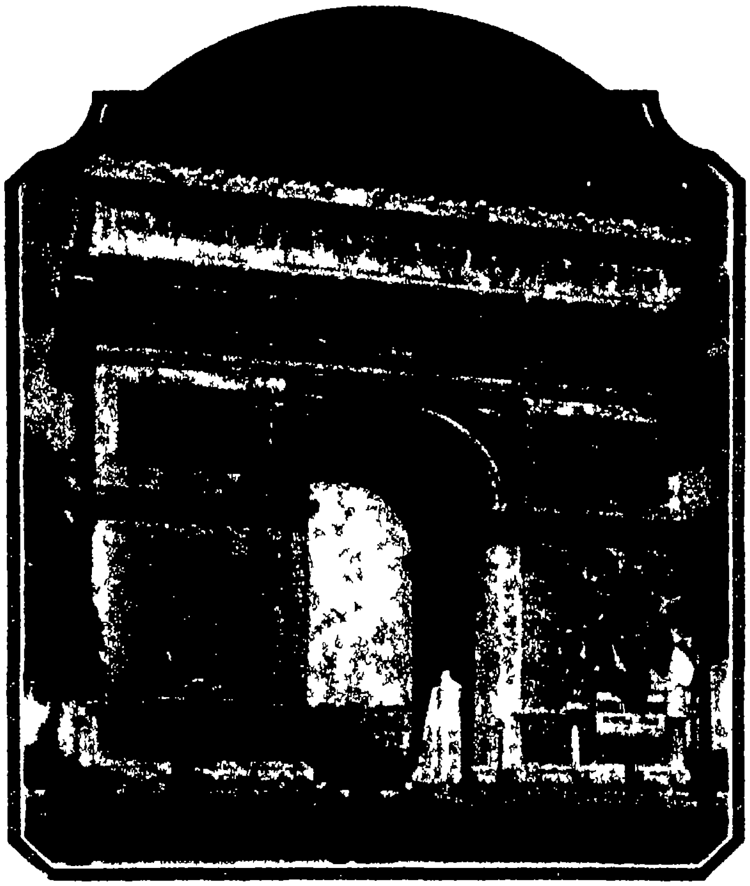

The Arc de Triomphe rising 162 feet at the head of the Champs Elysees Paris begun by Napoleon in 1806 one of the architectural masterpieces of the world

Striving to satisfy completely some deep-felt need of his fellow men, the architect has occasionally wedded beauty of line so intimately to useful function that his work stands a masterpiece of the builder's art

These architectural achievements find their automotive counterpart in the Lincoln In a comprehensive and fundamental way, this is a useful car It dispatches every function of the automobile with a brilliance gratifying to the most exacting motorist

And its beauty is so notable that it becomes, in reality, a factor in utility The inseparable blending of the two makes the Lincoln an authentic masterpiece

LINCOLN MOTOR COMPANY
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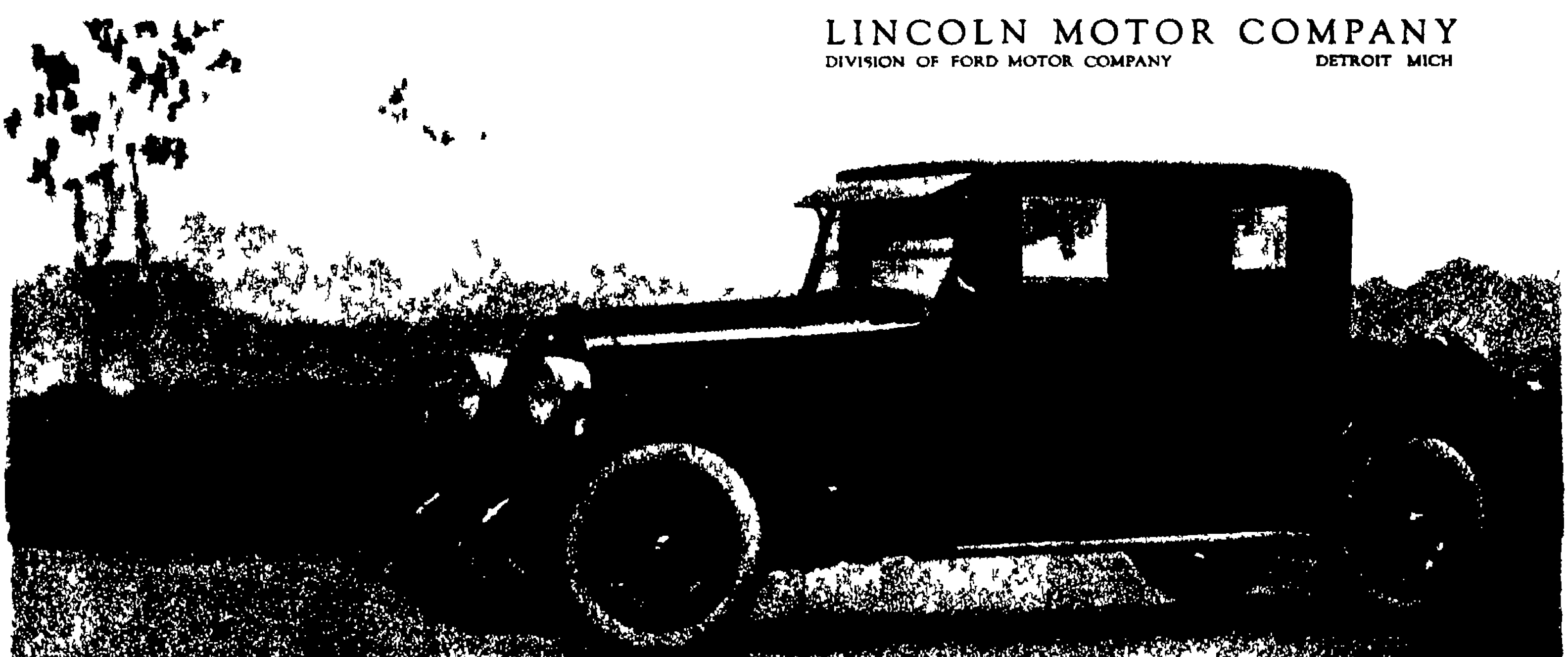

LINCOLN

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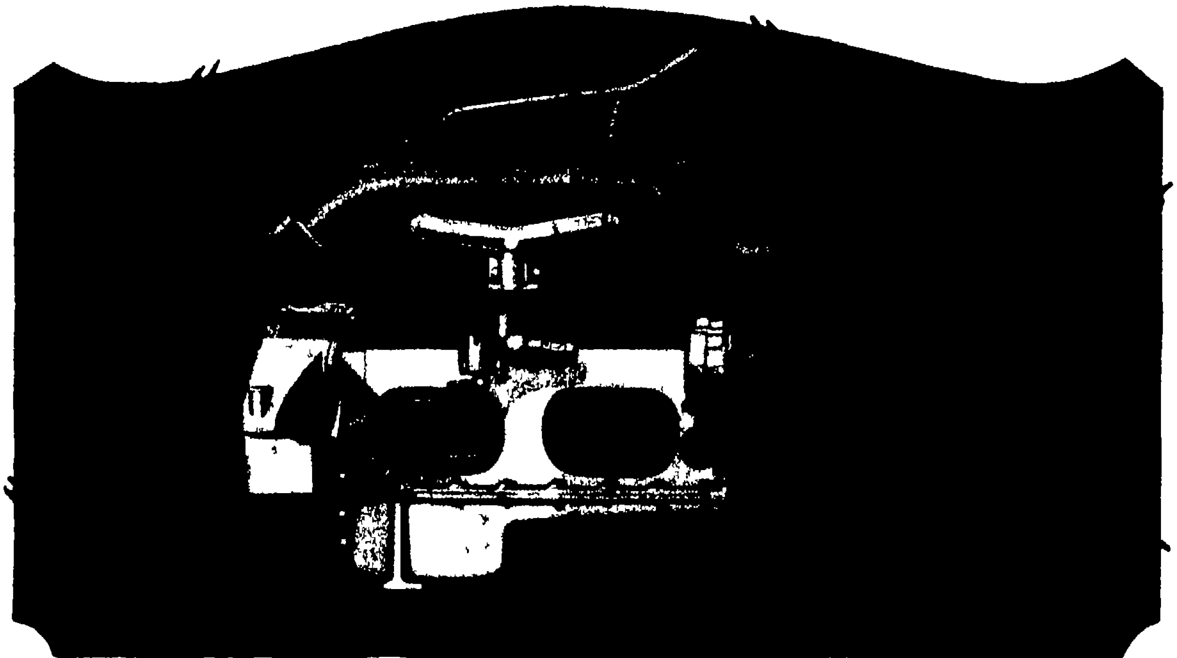

With the Editors

THIS is the Automobile Number. At this time of the year our thoughts turn gently—or rather, are turned for us—to the subject of automobiles. The advertisements and literature of the various automobile manufacturers proclaim the many virtues of their new offerings; the automobile shows tell of the greatness of the automotive industry; the new cars themselves excite the utmost curiosity at this time and until they become quite commonplace. So, all in all, the automobile is very much the subject of the hour at this time.

FOLLOWING a long established SCIENTIFIC AMERICAN custom we publish in this issue a chart of passenger car and commercial vehicle offerings for 1924. This chart will be found on pages 42, 43 and 44. Here in condensed form, will be found the salient facts regarding the various types of passenger cars and commercial vehicles so that the man with a definite amount to spend can shop to the best advantage.

THEN there is a review of the trends and tendencies of the 1924 passenger cars, prepared by our Automotive Editor, Victor W. Page. And a mighty interesting review it is, for the 1924 offerings include an unusual number of fundamental innovations. Then there is a review of the economic position of motor transport which must prove a revelation to many of us. Mr. Page has also prepared an article dealing with the relative advantages and possibilities of the air-cooled and water-cooled engines, which is a subject deserving far more consideration than it has received in the past. The question of lubrication and a discussion of the new balloon tires also figure in the automobile features of this issue. Attention is called to the ingenious pendulum drive graphically described by our British staff artist, Mr. S. W. Clatworthy, on page 13. This odd automobile drive is the invention of a well known Roumanian inventor residing in England, Mr. Constantinesco, whose remarkable system of wave-power transmission was described in these columns several years ago. This gentleman, it will be recalled, also devised the mechanism for timing a machine gun so that it will shoot through the sweep of an airplane propeller without touching the blades. His present invention is as efficient as it is strange and it presents considerable food for thought. It is one of those subjects which must be worked out.

UNDER the title Traffic and the Law we discuss the peculiarities of our motor codes and customs in various states. It would be a waste of time and valuable space here to outline the serious situation now existing as regards highway traffic. What with the automobile manufacturers steadily increasing the output of cars we are faced with a still more serious situation in the very near future. Not only in the matter of the standardization of state motor laws, but in the matter of highway facilities, grade crossings, ferry congestion, headlight glare, and other phases of present-day motoring we have a traffic problem which demands immediate attention. The SCIENTIFIC AMERICAN therefore proposes, during the coming year to devote special attention to the attempt to reduce the traffic problem to its fundamentals and to strike upon the best means of relief. The present article is the opening gun in this campaign.

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ELSEWHERE in this issue will be found the first article of a series entitled The Story of Steel. A short while back Mr. J. Bernard Walker, the senior member of our editorial staff, visited the steel centers of the United States, starting with the great open mine pits of the Missabe Range in Minnesota, then steaming down the Lakes with the ore to the huge smelting works at Gary, and then on through with the pig iron and steel to the various fabricating shops that turn out all manner of rods, rails, pipes, wire and so on. Back in 1902 Mr. Walker covered the same ground in a survey of the steel industry of that time, a special number devoted to the steel industry appearing in December of that year.

NEXT month, as usual, we shall have something in the psychic field. At the moment we do not know what it will be. Mr. Bird has just had a most interesting four-day psychic adventure which he will tell sooner or later. A series of formal sittings by our committee with an other medium begin early in December and presents the possibility that there may be enough for a story before the February number has to go to press. Some months ago we imposed upon the publishers of two epoch-making psychic books—Richet's Thirty Years of Psychical Research and Schrenck-Notzing's "Phenomena of Materialization"—to the extent of getting review copies from them. We have been waiting for an issue in which there was no other psychic story, intending to make a story out of these two volumes. One or another of these possibilities will supply the psychic material for February, and indeed it will be seen that we are fortified against a complete calm in things psychic of three months' duration.

FOR our February issue: A story on the romance of the lock by Edward H. Smith, who has written so many interesting articles on the science of criminology; a museum in the open air dealing with the wonderful life's work of Dr. Charles S. Sargent, who has the unique distinction of being the only director of an institution which has flourished under one management for over fifty years and is known today as the Arnold Arboretum, representing a collection of 5000 varieties of trees; the problems of the city planning engineer, not only in laying out new cities but in remodelling old ones; the energy of the atom and what are the chances of harnessing this energy comes in for a popular discussion by Sir Oliver Lodge; the heat of the earth always an interesting subject, is dealt with in an entertaining manner; what the Japanese earthquake did to the buildings of Tokio is told in a graphic manner by photographs, as well as by excerpts from the reports of American engineers in charge of reconstruction work; the queer customs of the head hunters of the Fly River, New Guinea, are brought to us in pictures; the latest archaeological discoveries in the French cavern of Montespan, and the great paleontological surprise in the form of dinosaur's eggs uncovered in Mongolia; the remarkable American dirigible Shenandoah and how it is navigated—these are but a few of the many interesting features which will go to make the February issue more varied than ever. And the cover for that issue, the navigating room of the Shenandoah or ZR-1, drawn from life by our artist, Howard V. Brown.

EIGHTIETH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JANUARY 1924

Blast Furnaces Coke Limestone Ore Steel Pig iron

Upper left Sheets and plates *Upper right* Steel rails.

Growth of steel industry in United States from 1902 (dark shade) to banner year 1918 (light shade)

THE STORY OF STEEL—(See page 28)

Typical open and closed models showing the simple but highly pleasing lines of the 1924 passenger car

Cars of 1924

Some of the More Interesting Features Revealed in the New Models

By Victor W. Pagé, M.S.A.E.

THE automobile as we know it today is not the result of conception of one brain nor does any particular model represent only the ideas of the immediate engineering and sales organization of the builders. The new models have been designed by the sales and service departments fully as much as by the engineering staff, and in the final analysis engineers and designers are often subservient to these departments in organizations producing large quantities of cars which must be built to meet a price. In such a case new engineering features cannot be looked for because they are non-existent. Features which might improve economy of operation or efficiency of the mechanism cannot be used if production costs are increased by their use. Some automobile manufacturers have so standardized their designs by the use of stock parts in the assembly that no real engineering or inventive skill is necessary and designers are dispensed with altogether. Study of such cars cannot be expected to disclose new features even though the value and practicality of the car itself cannot be questioned.

Automotive engineers do not believe as some car producers seem to imagine that there is no further room for improvement in existing designs. *There are many purely* mechanical problems involving suspension, engine balance or even carburetion and cooling that still cry out for solution. Much patient research and many chemical and physical experiments will be necessary before automobile design, even though it is well advanced, can be considered in its final stages. The modern trend on the part of manufacturers who really build cars, contrasted to those who only assemble them, is to bring out new and improved models every two or three years incorporating new features that have real engineering merit. The education of designers and engineers is a progressive and continuous process, but the reaction upon the actual commercial practice of car design is necessarily intermittent and spasmodic.

The automobile of today is too complex in its mechanism to have been evolved through any flash of genius, but it has been built up step by step, interspersed by many a stumble and a fresh viewpoint before real progress was made. It is for this reason that the columns of the automotive press and the meeting rooms of our engineering societies have been enlivened by discussions of the advantages and disadvantages of features that may be new to the present day motorist, but which are nevertheless ancient history to the old timer. I refer particularly to the lengthy and somewhat acrimonious discussion relative to four wheel brakes, which are by no means new. I have distinct recollections of hearing many of the same arguments when the (Scotch) Argyl car engineers broached their use over thirteen years ago. Then again, although the four versus six cylinder controversy has been settled by the selection of the simpler type by the majority of motorists who purchase our quantity production cars, we have in its place consideration of the merits of the eight in line engine compared to the eight cylinder V type. It is fitting to remark in this connection that the motorist who is the most ardent protagonist of a four cylinder car while he owns one is the first to graduate into the six cylinder class when his purse permits him to take this step.

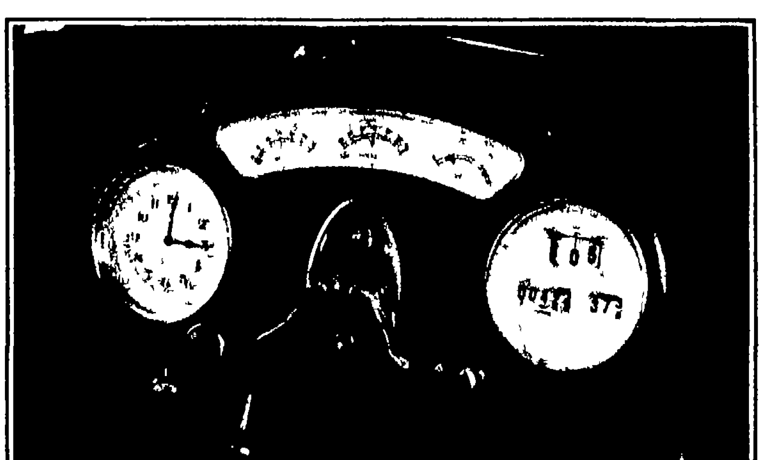
There is one thing that stands forth clearly in connection with power plant design, and that is the elimination of the twin six engine, the well designed eight cylinder types give every practical advantage to be derived from the greater number of cylinders and with much less complication. There can be no controversy between the six and the eight, as here again history will repeat itself. It will again be a matter to be decided by shekels rather than engine diagrams. The writer has always been an ardent advocate of the six cylinder engine for moderate cost cars and four cylinder engines for low cost cars. At the same time, if his means permits at any time in the future, the straight eight will serve very nicely as motive power because it is believed that this is the last word in motor car engines. The cost of repairs will be but little more than that of a six cylinder engine, the balance and torque or power application will be much superior.

A new closed car in which cushions and rear seat are removable to provide luggage space or sleeping accommodations

In former years there seemed a tacit understanding that cars below the $1,000 class would be powered with four cylinder engines, and this condition obtained for some time. This year however several makers have announced six cylinder cars for less than that figure, one prominent maker getting the jump on competition by announcing a small six phaeton at $750, while another is offering a six cylinder closed car at $950. In either case the builder of four cylinder cars of this class has something to think about and the motorist is the gainer. He can graduate to the superior type without waiting for the income-tax reduction.

For cheap cars and trucks, regardless of price, there is no type of engine that will prove superior to or supplant the four cylinder when utmost service and minimum complication are the main factors to be considered, and as racing engines have demonstrated, by increasing the cost of motor production and using a counterbalanced crankshaft the four cylinder may be made to run very smoothly. The increase in cost, however, might just as well be employed in building a six cylinder engine as in refining the four cylinder, because no four cylinder can give the overlapping explosions or power impulses of the six-cylinder engine, where even a crankshaft of ordinary design without counterbalance weights can be used and smoother running obtained than in a four cylinder. This explains why new low priced six cylinder cars are being offered for 1924.

Many new features of design are incorporated in the Packard straight eight. In *the motor itself an entirely new principle* has been worked out, accomplishing, it is claimed, the complete elimination of the unbalanced forces usually found in all but six and twelve cylinder motors. Instead of placing, in effect, two four cylinder motors end to end, as in some other straight eights, in the new Packard car a type of crankshaft is used that makes a radical departure from previous practice. Four crank pin throws—two at each end of the shaft—are set at right angles from the center four throws. This makes possible an interlocking firing order that cancels both the primary and secondary forces, eliminating, it is asserted, vibration completely. Packard engineers say that the unleashed forces in an out-of-balance motor can run to more than a ton. The Packard straight eight has a 3⅜ inch bore and 5 inch stroke, with the reciprocating mass weighing 2.31 pounds per cylinder; the connecting rods are 10 inches long. In a four cylinder motor with corresponding variables the engineers have worked out charts which would show that the unbalanced forces at 3000 revolutions a minute total 1475 pounds. In an eight cylinder V type motor of conventional design this same unleashed force runs up to 2080 pounds, while in a straight eight motor without the Packard type of crankshaft, and which has in effect two four cylinder motors joined in tandem fashion end to end, the unbalanced force reaches 2120 pounds.



The instrument board of the new year, as shown on one of the most popular eights

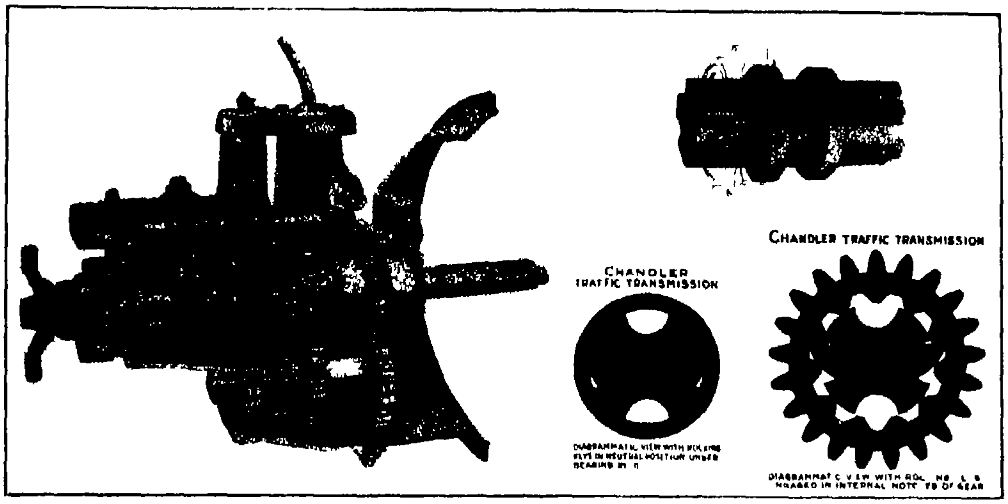
In the case of the Packard single-eight engine the secondary forces are concentrated at the center of the engine and are completely neutralized or cancelled out. Another way of viewing this proposition of perfect balance is to state that in any reciprocating engine which is composed of pistons, connecting rods and a crankshaft, in order to obtain freedom from vibration it is necessary to have the reciprocating and rotating masses in balance at all times. If these conditions are fulfilled the engine can be mounted on the frailest support and run at high speed without experiencing any difficulty due to exces

sive vibration. Of all the engines discussed the single six, twin six and single-eight with the new style crank shaft alone fill these requirements. The four cylinder, eight cylinder V type, or twin four, and usual eight cylinder in line or tandem four engines all depend upon being rigidly bolted to the frame for absorption of their inherent vibrations. Naturally these vibrations are transmitted throughout the car and cause considerable annoyance to the passengers especially at the so-called critical speeds. It is claimed that the single-six, twin six or new single-eight could be run at any car speed with the engine practically floating in space, there being no necessity for any of these engines to be bolted to the frame other than to support their weight and take the driving reaction.

As the culmination of nine years production of cars equipped with 90-degree V eight engines, the Cadillac Company announces a new type, the V-63, embodying the fundamental perfection of the V type 90-degree eight cylinder engine, inherently balanced and with major parts improved. The new engine marks the practical accomplishment of an engineering feat long considered difficult of accomplishment by automotive engineers—the inherent balancing of the reciprocating parts of the V type eight cylinder engine. With this inherent balance the V-63 retains and combines all of the obvious and admitted advantages of the short, rigid crankshaft and crank case giving maximum rigidity in the engine structure and economy of chassis space, coupled with hitherto unknown smoothness of operation. The inherent balance of the reciprocating parts in this engine is the result of a new arrangement of the throws of the crankshaft. The four throws or cranks are in two planes at right angles to each other instead of all in one plane as in the previous V eight practice. That is, when viewed from the end, if the crankpin at the forward end of the crankshaft be considered to correspond with the figure XII on the dial of a clock, the second, third and fourth crankpins would fall at three, nine and six o'clock respectively.

Compensators or counterweights are used and these, in combination with the new arrangement of crankshaft throws, cause the whole assembly—crankshaft, connecting rods and pistons—to operate with the smoothness of a balanced flywheel. With this rearrangement of the crankshaft throws a new firing order has been established. The same firing interval is maintained, uniformly spaced as on all Cadillac eight cylinder engines. The firing interval, it might be said in passing, is conditioned by the angle between the cylinder blocks, and the power impulses occur regularly every quarter revolution of the crankshaft. With no other angle than 90 degrees will an eight cylinder V type engine have a regular firing interval and a uniform overlapping of impulses. The continuous flow of power characteristic of the Cadillac engine is due in a large measure to these factors.

The discussion that obtains about four wheel brakes reminds the writer of an equally heated controversy of several years ago relative to the advantages of four wheel drive for trucks as opposed to utilizing only the rear wheels for traction. There was no question about the increased traction obtained by supplying power to all four wheels instead of only two, and here again the example of a locomotive in which power was applied to



Left: Cut-away view of the entire transmission showing how all gears are constantly in mesh. Upper right: The slotted shaft and the key with gear shown in phantom. Lower right: The action of the key when idle and when at work

Details of the new "traffic" transmission, which shifts with the familiar motions, but without any meshing of moving gears

six or eight driving wheels and superior traction thus obtained was cited as an example of why trucks would be better if all wheels were driven. Very convincing arguments were advanced and four wheel drive trucks did all manner of stunts to show their superiority over those employing the more conventional system of drive. Yet there are no more makers of four wheel driven trucks now than there were then. This of course is not because the four wheel drive was found to be impractical. In my opinion the reason was that two wheel drive trucks were adequate in 95 per cent of the places where trucks could be used advantageously and the greater mechanical complication of four wheel drive militated against its general adoption despite its proven superiority as a means of securing positive traction.

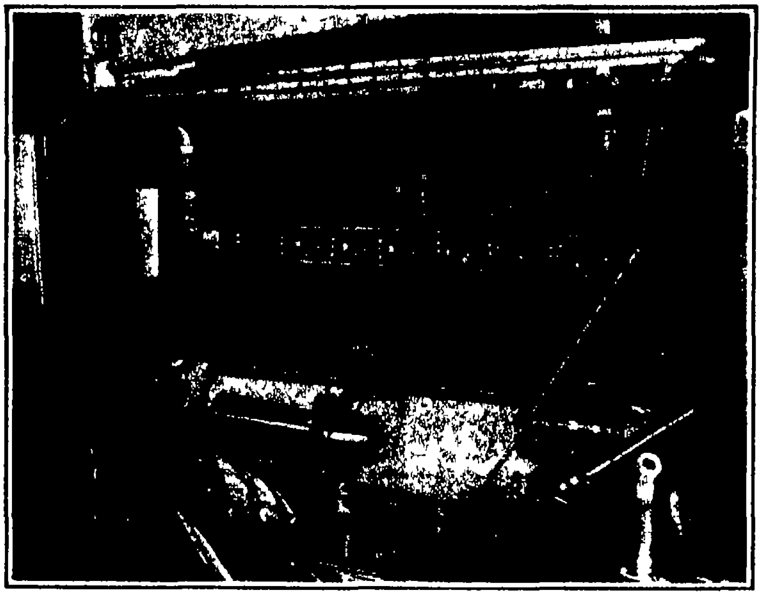
The situation is somewhat the same in my mind where four wheel brakes are concerned. No one will question the fact that one can stop a car quicker by stopping rotation of all wheels than if only two wheels are braked. At the same time no one can argue justly that four wheel brakes do not involve added mechanical complication in an already complicated mechanism. Little fault can be found with a well designed two wheel braking system if it is kept in adjustment. The reason two-wheel brakes have proven inadequate in some cases is because the design was not all that could be desired or because adjustments were neglected. Why anyone will expect the motorist or mechanic who now neglects a two wheel braking system both as regards adjustment and condition of brake linings to be any more anxious about a system involving twice the work because it has twice as many parts is beyond my reasoning powers. The writer does not question the advisability of using four wheel brakes on expensive heavy and fast cars, but from a number of years of service station experience he does question if they will work out under actual conditions of neglect and even abuse that cheap and light cars receive. The motorist who neglects to lubricate the bearing points of his chassis, fails to keep his tires properly inflated and even forgets to put oil in the engine or water in the radiator, cannot by any stretch of the imagination be pictured giving four brakes the attention he now forgets to give to two.

The writer concedes the point that the brakes will function properly if they are maintained as they should be, and he agrees with the designer who has spent many weary hours over the drafting board perfecting the four wheel brake system that works so well under test and in road demonstrations, that the system could not be expected to work well if neglected. One cannot put engineering brains into the head that abhors technical detail. As Grover Cleveland said, "It is a condition and not a theory that confronts us." If four wheel brakes receive the attention their merits deserve they will give satisfaction, but two wheel brakes work well under the same conditions. The fact that a Pullman car has twelve pairs of brake shoes is not a logical argument to use for the purpose of proving that an automobile should have four sets of braking elements, one in each wheel, in addition to a transmission brake and the ability to use the engine as a brake on occasions.

There is no question but that four wheel brakes have caught the motoring public's fancy and they have been hailed with delight by municipal and highway authorities who realize the many accidents resulting from unreliable braking systems. There is much to be said on both sides. Some makers are very enthusiastic about the four wheel brakes but qualify their enthusiasm by the cautionary advice to the purchaser that theirs is the only practical system, all the others are a snare and a delusion. Some more conservative car builders furnish them at extra cost if the purchaser desires, while other manufacturers in order to be consistent in their advocacy of the innovation equip all their cars with four wheel brakes even to light four cylinder cars where the two wheel brakes have always proved to be adequate in the past.

Every maker advocating four wheel brakes makes provision to prevent locking of the front wheels when the brakes are applied on account of the danger if a rapidly moving car was stopped suddenly at a time when the wheels were swung around by the steering mechanism in rounding curves. Suppose some ignorant motorist or repairman alters this adjustment after the car leaves the factory so that the brakes do lock?

Typical interiors of some of the fine cars of the new year indicating the efforts being made toward still greater comfort and convenience



The eight cylinder in line engine is not quite so long and lean in appearance as its name might indicate

Under these conditions the advisability of using the brakes on the front wheels is justly open to question. Suppose the mechanism is so designed that it is impossible to lock the front wheels and only the rear wheels can be locked by the brakes? The bulk of the work is then done by the usual form of rear wheel brake; the others on the front are supplied only as a point of sales talk. As long as the ability to steer a car depends on the rolling motion of the front wheels stopping this motion absolutely must inevitably make the car difficult to control.

Unusually heavy eight throw crankshaft for straight eight

The problems involved in four wheel brake designs are manifold although not quite so manifest—to the layman. The mere adding of another pair of brakes to the front wheels does not constitute a workable four wheel brake system. Had that been true the first automobile ever made would probably have had brakes on all four wheels, for it is a matter of common knowledge that railway cars, for example, have brakes on all wheels. In an automobile we have many problems that do not arise in the building of any other vehicle, and these are due to the facility and ease with which it must be steered over any kind of road surface. For example, one would say that if the strain on the wheels were equalized so that the pressure between the shoe and the drum were precisely the same on each, a perfect four wheel brake should result.

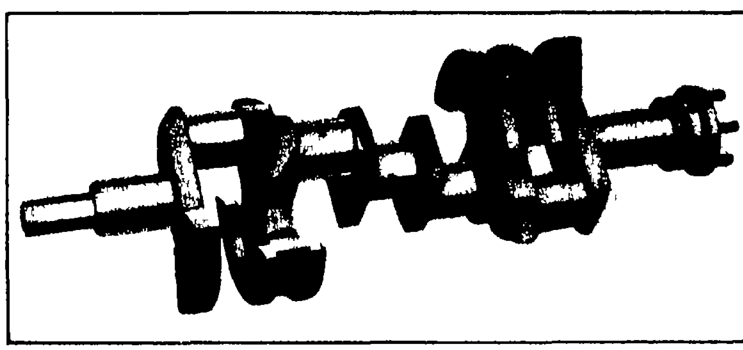
Not at all! It is not so simple as that. In the first place the braking effect must not be precisely the same on front as on rear wheels. The car must always have steerage way, which is to say the front wheels must continue to "roll"—never lock—under any circumstances. Neither is it desirable, of course, that the rear wheels lock. But no brakes have ever yet been made that a driver could not, under certain circumstances, lock if he applied them quickly enough and with sufficient force. To render impossible the locking of the front wheels the strain between front and rear must be differentiated.

One of the most ardent protagonists of four wheel braking systems operated by mechanical means is the Rickenbacker Company, who were among the first to announce the use of this equipment. In the Rickenbacker system this is accomplished by different degrees of leverage exerted from the foot lever to front and rear. Of course, the left wheels, both front and rear, must be equalized with regard to the right so as to take care of the difference in traction under different conditions. This has always been done in the Rickenbacker with the most approved type of equalizer—the differential gear type.

Another differential equalizer now accomplishes the same purpose for the front wheels, and it is interesting to note the neat way in which this has been worked out. The differential mechanism is contained in the hub of the brake pedal itself, making one of the neatest installations the writer has yet seen. But they still had another and more difficult problem, one which few European engineers have so far succeeded in solving.

Of course, four wheel brakes would be of little use if they did not operate just as well when turning, for in emergencies the quick thinking driver uses his steering wheel as well as his brakes to avoid collision. Obviously both must work perfectly and, above all, the brakes must not interfere with the steering. As an extra precaution against the possibility of locking the front wheels when turning the brakes are so designed that as the wheels assume the turning angle they practically let go. In driving this actually gives the driver better control of his car.

Brakes are all of the internal expanding type and, of course, the shoes are in two equal halves or segments. The fabric surface of one segment will frequently wear more than that of its twin. This must be constantly and automatically compensated for. In the Rickenbacker car is a diamond shaped shifting block which automatically accommodates itself to the difference in thickness of the brake lining and exerts precisely the same pressure on oppo-



The balanced crankshaft of a new V-eight, with cranks in two planes instead of one. This shaft is shown assembled in its engine in the next view

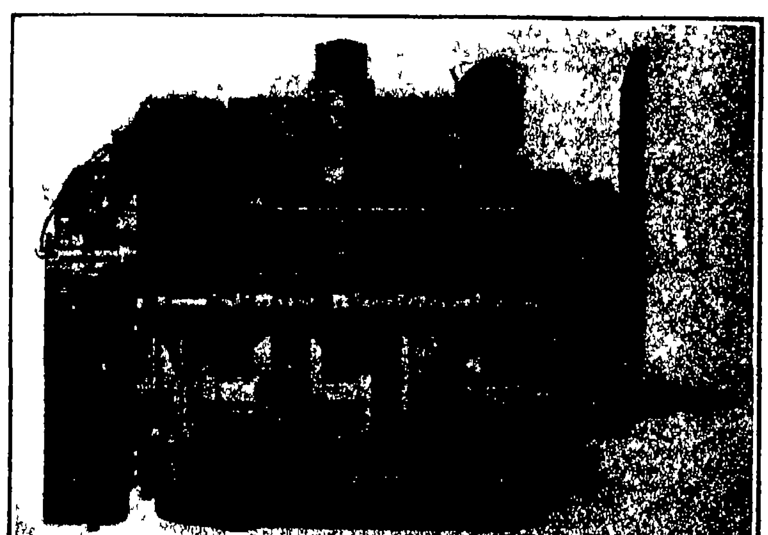
site sides of the drum. Another little point but a very important one: this automatic equalizing block, as well as the cam itself, is freely lubricated from the drip oil which comes down from the steering spindle, all of which are enclosed so that only one oiling point is necessary to provide all these parts with constant lubrication. The front brake-shafts, on the outer end of which is the cam above described, are neatly concealed in housings integral with the front axle forging, and from the point where it leaves the axle to the point where it enters the wheel it is encased in a water and dust proof boot which is packed with grease. This integral housing also serves to reinforce the axle at the point where the extra torque stress of the front brakes exerts greatest effort.

Inasmuch as the drum must be free to revolve, of course there is a slight clearance between the outer edge of the brake anchor-disc and the revolving drum into which water could enter, if driving through a deep puddle or stream, although centrifugal force of the revolving drum makes this impossible under ordinary conditions. To provide against such unusual happening, holes have been drilled around the drum to permit any moisture to leak out. In fact it would be thrown out by centrifugal force. These holes serve another valuable purpose. They are counter sunk on the inside so there are no rough edges to catch the friction which constitutes the brake lining, and they permit the air to escape when brakes are applied, so that the contact between the shoe and the drum is uniform and positive, whereas in the ordinary brake air pockets are liable to form and prevent efficient braking.

Adjustments on Rickenbacker four wheel brakes have been developed to the point where it is claimed to be actually easier to adjust the four—and it can be done in less time—than the ordinary type can be adjusted on the two rear wheels. A plain monkey wrench is the only tool necessary and a one-sixth turn of one adjusting nut on each brake. One person can do it and without soiling his hands or sleeve. If "one notch" on each is not sufficient another notch will invariably compensate for any ordinary degree of wear since the last adjustment. The illustration shows the device by which this is accomplished.

The brake-shoe anchorage consists of a split sleeve, the inner surfaces of which each have one variable-depth slot. Wedges fit into these slots. As the wedges are drawn in by the turning of the adjusting nut the split sleeve expands against the brake shoes forcing them apart, thereby achieving the desired result of adjustment for wear. Notches are milled in the threaded section of the adjustment nut and a steel ball, held in place by a spring, snaps into each slot as the nut is turned. As there are six of these slots the ball will snap into place six times in one full revolution. The "feel" of this operation renders it ridiculously simple for anyone to adjust these brakes. Contrary to usual practice, the pull rods are never touched except when assembling the brake at the factory or when a new lining is being installed in the service station. Then the expanding wedge is backed all the way off and the rods adjusted to meet the new condition, after which the only adjustment necessary is that above described.

Rickenbacker engineers insist that the life of brake linings is increased many fold when the braking service is distributed over four, that the car will run fully ten times as many miles between adjustments, that tires wear longer, that strain on brakes and every other part of the car is less because of the distribution of these stresses over two axles instead of one and over four springs and four wheels instead of two. While to the layman it would appear that these engineers insist that vastly greater results are achieved than would appear on the surface, their contentions are reasonable because



Side sectional view of new V-type eight, showing new compensated crankshaft, single camshaft with 16 cams and other new features

of the fact that there is less pressure per square inch of braking surface, less friction per square inch, therefore less heat generated, and the heat always remaining at a much lower degree, radiates much faster. Less adjustment range is needed with this type of brakes, although in the Rickenbacker design more range is provided.

The life of the brakes as well as their efficiency is very greatly enhanced by the fact that the drums are accurately machined, which distributes the friction evenly over the entire surface of the linings and drums. By the method of anchoring and adjusting the shoes are always concentric with the drums so that the wear is absolutely uniform. In fact the driver could wear his linings wafer thin and still they would operate as well as when new. The average brake shoe wears like a shoe on one's foot—in one or two places—whereas the Rickenbacker shoe cannot but wear evenly all around. Another interesting claim is that while theoretically the same amount of foot pressure should be necessary to accomplish the same result with four wheel brakes as with two, experience proves that it requires considerably less than half as much. Also, that while theoretically again a car of given weight should stop within half the distance it really stops in less than half if the driver so desires. In a word less than half the pressure of the foot stops the car in the same distance as with two wheel brakes while the same exertion stops it in less than half the distance.

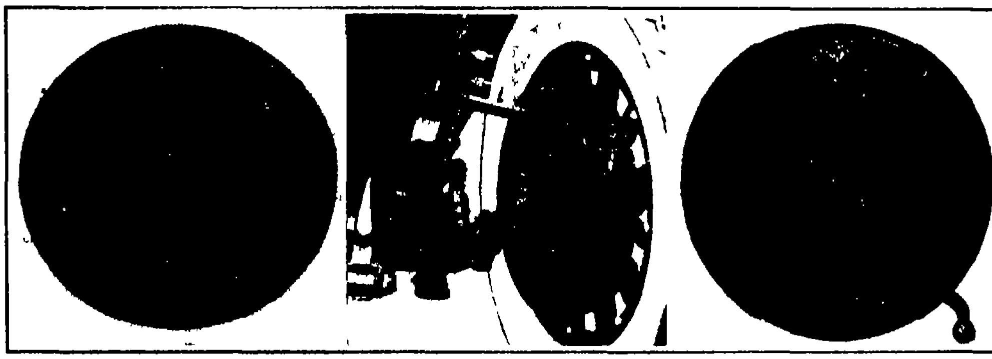
All engineers who favor four wheel brakes do not agree on the details of construction and application any more than they do on other points of automobile design. The Buick cars are provided with external constricting band brakes but most cars employ internal expanding bands or cam separated shoe brakes. In the Duesenberg car which embodies a number of interesting engineering features including an excellent straight eight engine design the four wheel brakes are not an innovation inasmuch as they have been provided on stock models for some time. In this car the internal brakes are actuated hydraulically, this method also providing for compensation or equalization without mechanical linkage. A master cylinder is mounted on the transmission case, the brake pedal being attached to a piston rod which forces oil out of the cylinder through pipes running to brake-operating cylinders at the wheels. A reservoir mounted adjacent to the brake cylinder insures that it will always be filled with liquid.

Note tubular front axle, hydraulic brake-line connection, complete enclosure of brakes, double support for steering arm, etc. At the left is shown the master cylinder for operation of the brakes mounted on transmission case, with brake liquid reservoir mounted outside

Typical hydraulic front wheel brake showing wheel installation and reservoir

Several other makers have announced hydraulically operated brakes for the coming season but most brakes are operated by the usual mechanical linkage.

One of the most improved and distinct mechanical features of the year is the multiple-disc self adjusting clutch recently announced by the Cole. For some time Cole engineers have concentrated their efforts on the development of a clutch that would give ease in the shifting of gears as well as silence which is considered one of the outstanding attributes of a finer motor car. Disc clutches have been used in motor car power plant for years and essentially they have not changed in their construction or operating efficiency since their inception. The new clutch is an eleven plate multiple disc and not a single plate type. Among the features that make it stand out mechanically is first the elimination of any tendency to clatter, grab or distort. This is done by the use of special steel stock and special milling process in making the plates. And in addition to this a second point of novelty is the construction of the fabric friction plates. Instead of building upon a plate of solid fabric composition or riveting the fabric on to the face of the steel plate a corded fabric has been woven into the plate itself. This special combination *fabric and steel plate because of its integral construction* absolutely resists the deteriorating forces that have in the past prevented the highest efficiency in clutch operation. This new construction will eliminate the troubles of fabric ripped off the plate through strain or the solid fabric plates broken under the strain and pull of the plates. The feature that makes the clutch self adjusting comes from the six coil springs that keep the plate snugly together at all times. As the fabric wears and space is created between the plates these springs take up the play keeping the fabric pressed tightly against the steel plates which feature however seems to be shared by almost all spring controlled friction clutches.

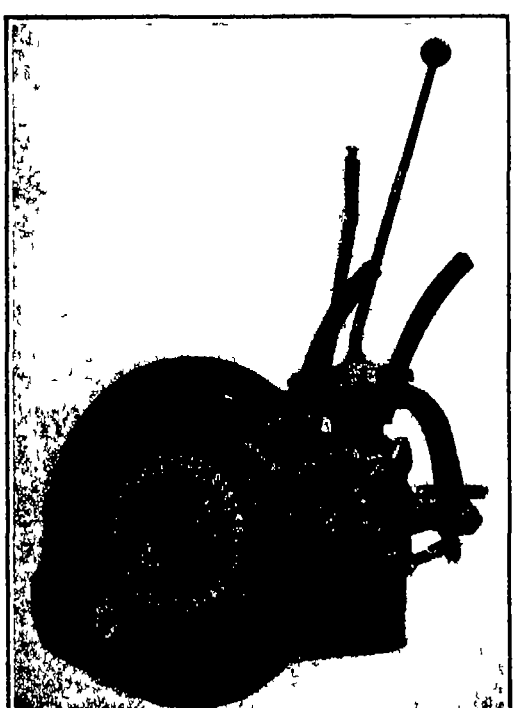


Left Rickenbacker *Center and right* Cadillac

Three views of the front-wheel members of two mechanically operated four wheel braking systems

On the new Chandler cars one finds a gear set construction of the constant mesh type that is reminiscent of the gear box formerly used on the Berkshire cars, a New England product that only pioneers in the industry will recall. The principle is a practical one and of course is a great improvement over the earlier form of sliding key engagement. The new construction is clearly outlined in the accompanying illustrations. The big advantage is that speed changes can be made in either direction and with equal facility and at any speed of car and engine and the method of operation is such that the motorist does not have to learn to manipulate it—*the lever shift is the same as with any sliding gear* set operating on the selective principle.

The illustration shows the Chandler transmission cut away to reveal the shafts and gears. Note the solidity of the layout and the sturdiness of the gears. Note also that in general it follows the layout of the ordinary transmission. In the old fashioned gear set gears were changed by sliding the gear wheels along the driven shaft which was slotted so that the gears must always revolve with the shaft. In the new transmission the shaft is free to revolve within the gears which however, do not slide back and forth. They remain in mesh with their corresponding gears just as the constant mesh gear of the sliding gear transmission always remained in mesh turning the countershaft. The sliding keys are visible to the left of the gears and the forks that slide them. When it is desired to engage any particular gear the shifting lever is moved to the desired position. This causes the heavy keys shown in the smaller views at the right to slide in the deep grooves in the shaft. When all gears are in neutral the heavy lugs on the ends of the keys lie wholly within the bearing rings upon which the gear runs when sliding. Two of these rings support each gear. When the keys are shifted they move clear of these rings and when clear rock the heavy lugs out into the deep notches cut in the internal circumference of the gears. The keys are bound to rock fully into place because the action of the gears themselves turns the keys into their proper position. Note that the gear is locked to the shaft so that it cannot revolve in either direction thus eliminating backlash. When the keys are engaged they cannot rock farther being restrained by the heavy bearing rings.



A new self-adjusting multiple-disc clutch using plates with woven corded fabric

Another innovation that has received practical application on the Apperson cars is a mechanical gear shift in which all hand operation of a gear shifting lever is eliminated except for a small pre-selection change speed lever on top of the wheel which can be operated by the pressure of the finger or thumb. The actual gear shifting unit is bolted to the transmission below the floor and is out of sight. The operation is simplicity itself, the selector lever is moved to the desired position and pushing out the clutch in the usual manner shifts the gears. This system provides a clean front compartment floor as there are no levers to interfere even in a slight degree with the comfort of the occupants. The advantage of the pre-selection principle is that while the car is being operated in one speed—say high for example—it is possible to set the selector lever to the notch indicating second speed and on the next movement of the clutch pedal the gear is automatically shifted by positive mechanical means without the motorist's taking his hands from the steering wheel.

No discussion of new features of motor cars would be complete without brief mention of low pressure oversize or balloon tires as they are called. The most essential feature of the balloon low pressure tire is the cushioning effect it gives the machine when on rough roads. It has been found by many experiments that when driving on a very rough highway with many chuck holes the car is given a kind of rolling effect instead of jolts that are uncomfortable to passengers and injurious to the car. Of course the ups and downs of the road are still there and the car goes up and down with them but everything is cushioned so that there are no sharp shocks and jolts and one does not have to watch the road or put his body in a tense condition to get over the rough places nor be worried about being *tossed up from the seat. Furthermore* the driver does not have to pick out all the good places in a

(Continued on page 66)

The Economic Position of Motor Transport

Motor-Vehicle Economy and Mobility as Realized in the Truck and the Bus

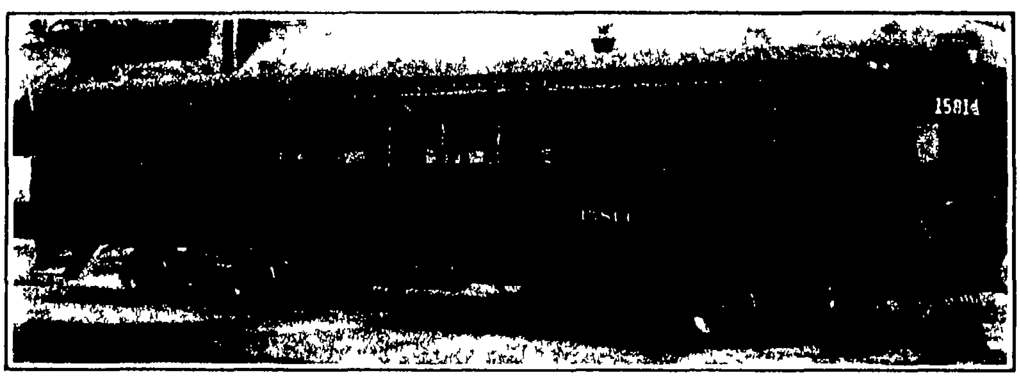
THERE is no economic problem of greater basic importance today than the unifying of all means of transportation into one sympathetic system. The urgent necessity of moving people and materials with the utmost expediency and economy has direct and obvious bearing upon the progress of the country financially, industrially and commercially, and therefore upon the cost of living generally. Significant present day developments in transportation are tending unmistakably towards better coordination and cooperation between the four main units, steam roads, electric railway, ships and motor vehicles. Out of the confusion and friction of the past an orderly system is being gradually established to the elimination of wasteful methods and destructive competition. It is hoped that in the near future we will see a new era in this field.

The outstanding factor in the linking of railways, highways and waterways is, of course, the rapidly expanding use of motor vehicles. Rail and water carriers are of ancient origin, the amazing growth of the motor industry has taken place in little more than a score of years and only within the last few years have trucks and buses taken their permanent place as essential transportation units. Yet in that short space of time a great legion of trucks has been sent forth on its mission of carrying the products of field and forest and mine to railway platforms and docks and factories and eventually to stores and homes, an immense fleet of buses and taxicabs has given its contribution to the task of moving millions of persons within cities and between communities, supplementing and extending the service of rail and inland water lines. The cooperation of railway companies has resulted in the development of a special form of motor vehicle adapted to use the railroad right of way.

The number of motor vehicles of all kinds in the country has now reached 12 239 114, while production last year reached 2 659 000, an advance of 22 per cent over the previous year. The suburban use of cars and motor trucks is an example. Around our big cities are areas of land used by home seekers. Without motor vehicles only land within walking distance of a railroad station has been readily available. With the motor vehicle each station becomes a center for home development for a radius of several miles. Long Island, a part of the area in the New York Metropolitan District, illustrates this point. In 1917 there were 11 800 motor cars in suburban counties of this Island and there were 50 796 000 passenger fares on the railroads serving the territory. In 1922 there were 41 000 cars and the railroad passenger total had grown to 79 050 000. In the same period motor trucks increased from 2 482 to 10 000 and the freight carried by the railroads advanced from 5 271 000 to 6 028 000 tons. There have been several thousand new dwellings per year constructed in this region, 1922 set a new mark with 23 326.

The rail lines are not leaving it to private individuals to discover the advantages that may be obtained through developing territory intensively by use of the motor vehicle. Forty railroads are using flanged wheel motor buses on their short lines. The American Short Line Railroad Association finds that many lines operate these buses at a cost of from 10 to 25 cents a mile, including all charges, as compared with the cost of 65 cents to $1.00 to the rail line in the operation of steam trains. Where only a one or two car train is needed on the short line route the saving in the use of the gasoline car is obvious.

The motor industry now is in the legislative period of its development, a flood of laws and proposed measures relating to the regulation of these modern carriers of the highway has followed in the wake of their wider utilization and legislative hoppers in every state have been jammed with thousands of bills. Without question there has been some wise legislation enacted with the view of promoting and encouraging this newest of giant industries. It is likewise certain that there have been passed many laws destructively restrictive.



The service rail car, an eight wheel type that follows steam railroad practice in car and truck construction and motor vehicle precedent in power plant, transmission and change speed gearing

While we are long past the days when a man carrying a red flag walked ahead of the motor vehicle to warn other users of the highway of its approach, or those more recently in which Iowa farmers got together in their granges to warn all members against having any business dealings whatever with owners or operators of the modern juggernaut of the road, the horseless buggy, there still exists in the minds of many misconception of the true importance of motor vehicles and of the attitude of the automotive industry towards legislation affecting its interests. There is much comment, for example, to the effect that passenger cars, trucks and buses are not paying their rightful share of taxation, that public highways are being destroyed by their use, and that unfair competition has been set up against steam and electric roads. That this is not generally true is proven by figures published that show in some states that the motoring taxes are twice the amount spent on road building and repair.

It is not generally understood that the burden of assessment placed against the industry in many states has been out of all proportion to its ability to pay, that the motor vehicle has been the most powerful influence towards the building of better roads so necessary for economic advancement, and that trucks and buses are in actuality cooperating and not competing units in the transportation system. The public is willing to pay for service and if motor buses do the work better, quicker and cheaper than other methods it will necessarily be a case of the survival of the fittest.

Nor is it widely understood that far from opposing intelligent regulation and taxation the automotive industry has consistently advocated reasonable regulations and the imposition of taxes sufficient to cover the entire budget of State Highway Departments for the maintenance of improved highways. The United States Bureau of Public Roads reports that the total of motor vehicle taxes for 1922 was $334 001 209. In some states the amount of such taxes far exceeded the highway maintenance budget. In this connection it is interesting to note that one of the largest truck manufacturing companies, which has paid out a total of more than $12 000 000 in dividends over a period of years, has also paid in excess of this sum for State and Federal taxes.

One of the striking aspects of motor vehicle legislation is the wide variation in the licensing fees of the various states, in the basis for fixing fees and in those elements which are closely related to the cost of highway construction and maintenance, namely, weight and speed of motor trucks. While exact uniformity of regulations and restrictions may not be possible because of differing local conditions, it is certain that manufacturers and operators of trucks and buses, as well as highway engineers, must be given some fairly standard code acceptable to the states as a whole upon which the problems as to weight, speed and tire impact may be worked out.

It is being recognized that it is folly to bar the so-called heavy duty truck from the highways as has been the endeavor in some states, such procedure would result in the use of two trucks instead of one with consequent greater damage to the roadways as well as higher operating costs. In the matter of gross weight there should be a limit, of course, the Motor Vehicle Conference Committee has submitted its proposal for 14 tons gross and upon this basis highways of the future are likely to be built. It should be recognized, however, that it is the unit weight per inch width of tire supporting the load and in contact with the roadway that counts. Very heavy loads may be carried without injuring the surface if the wheels are of sufficient width.

The chief point to be considered in connection with the highways is that they should be built to carry the necessary traffic rather than so poorly or cheaply constructed as to act as a bar to economical hauling. The public mind should be educated to consider the value of good roads from the standpoint of actual decrease in the cost of commodities through decrease in the expense of transportation. If it is good business to build a railroad rail bed so that it is adequate for any demand that may be made upon it, then paved highways should be built to meet the same conditions. The value of paved highways lies in their destruction through use and not in their preservation through uneconomically restricting that use. The only possible use to which paved highways can be put whereby value received can be realized must be commercial use. Political considerations must give way to efficient road construction. The public must receive what it pays for.

State lines should no longer be drawn in transportation matters and legislatures should act to make uniform highway rules and regulations, together with laws as to licenses and fees in so far as possible, for the purpose of encouraging transportation and therefore for the purpose of decreasing costs to the consumer. In fact many people who have given the subject consideration seem to believe that Federal rather than State, control is what will be necessary. Commercial motor vehicles are here to stay—they have become and will remain absolutely necessary parts of a unified and efficient transportation system, and the expansion of the facilities afforded by their uses should be encouraged by reasonable legislation, rather than retarded by ill advised prohibitions. It is a shortsighted policy that has prevailed since the beginning of history to attempt to limit and restrict progress by legislation and to judge what would be proper in the future by the limited outlook obtained from a consideration of the past.

Old fogyism has always been a stumbling block to progress, and if motor transportation is to be circumscribed by hasty and ill advised legislation the industrial growth of this country will be proportionately stunted. Upon this belief not only the manufacturers of motor vehicles are agreed but also an increasing number of rail and water line operators who are demonstrating by the purchase and utilization of trucks and buses the value of these mobile units as adjuncts of their own service. More than 100 electric railways in 23 states now operate more than 1000 buses and feeders and extension units, the use of trucks by railroads for less-than-carload lot hauling and terminal service is growing constantly, and gasoline-engined rail cars, closely akin to motor trucks, have been the salvation of many companies operating short lines which were unprofitable with steam or electric trains but which now show a profit with the more efficient rail cars. In every state the public, as the buyer of the commodity of transportation as well as the real owner of its properties, should be seeking the enactment of wise legislation to improve its trade arteries and carriers and to safeguard its tremendous investment in them.

Fourteen million passengers were carried in motor buses operating in the State of California during 1923. This figure, staggering in itself, is but an indication of the tremendous strides made in bus transportation during the last few years, bringing the passenger carrying bus into full partnership with the nation's leading transportation facilities. Following closely in the footsteps of California, buses operating in Ohio last year carried nearly 12 000 000 passengers, while bus lines operating in Minnesota report 10 000 000 people carried

over a like period. Records of bus transportation in other states would reveal figures of equal magnitude. The year 1924 undoubtedly will show a big increase in the number of passengers carried.

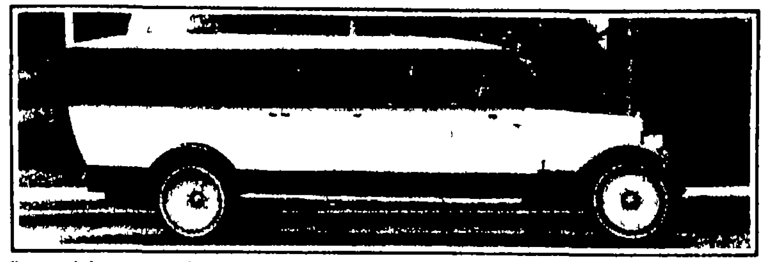
An important trend of bus development, and a fairly recent one, is indicated by the scale on which electric rail lines are purchasing and operating motorbus equipment. A record along this line is believed to have been established by the Pacific Electric and Los Angeles railways in purchasing 81 buses in a single order. Fleets equally large are operated by independent bus companies. Indicative of the place the motor bus is carving for itself, one manufacturer reports that four electric traction companies alone operate close to 200 of its buses in conjunction with street car service, while all told more than 4500 of its vehicles are running on schedules measured and timed by public convenience in every state in the Union.

The motor bus, because of its extreme flexibility, is not limited in its operation but is capable of efficiently serving the public wherever there is need of passenger transportation. Buses are now being operated with much success in city service, as traction line feeders, on inter-city lines, for de luxe tours, for schools and institutions and for parks and sightseeing. They have become within a few years a very definite part of the country's transportation system.

In the four years preceding the war the ratio of increase in passengers carried on motor buses in London was 136 per cent, as compared with a ratio of increase on the tramways (trolley cars) of only 18.7 per cent. There are over 4000 buses operated in Greater London every day, handling an average of over 2,000,000 passengers. Late figures on bus operation in Paris are not obtainable, but those of 1913 show that in that year there were in daily use 1032 buses. The increase in passengers carried on motor buses from 1911 to 1913 was 81.4 per cent, while the increase on subway and trolley lines combined was only 10.2 per cent in the same period.

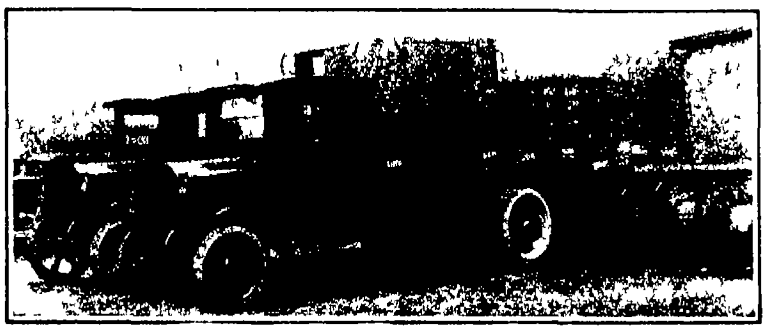
Recent figures on motor bus operation in New York City prove even more conclusively the increasing popularity of the motor bus as a passenger transportation medium. In 1910 passengers carried by buses in New York City numbered 6,503,173. In 1921 there were 51,091,305 bus passengers, or an increase in 11 years of 710.31 per cent. From 1910 to 1918 the increase in the number of passengers carried by the surface lines in New York equalled 8.4 per cent, as compared with the 344 per cent for the motor buses over this eight year period. With the above figures as a basis for speculation, it does not require an exceptional vision to predict the future of the motor bus. Just as the motor truck successfully proved its economy and dependability as an independent freight carrier, so is the motor bus fast becoming a vital factor in passenger transportation. It is not only serving as an adjunct to city and interurban lines, but is assisting in the development of areas surrounding the larger centers of population heretofore inaccessible to the home seeker.

When the demand for motor buses became great enough, manufacturers who had supplied their regular motor truck chassis for this work learned that the ordinary chassis, so well adapted for commercial use when equipped with a van or dumping body, was not an ideal passenger vehicle when fitted with a bus body. In the first place the truck speeds were too low, and the chassis frames and springs brought the bus floor too far from the ground. Naturally, as the demand became greater and more buses were put into operation, the factory engineers working in cooperation with the service men soon had compiled and digested the experience of the various users, and special chassis designs were evolved that were especially adapted to wholesale passenger transportation. By dropping the front axles and underslinging the front and rear springs, and in some instances by having the frame side members dropped between the springs, buses were evolved that were easy of access and that carried their loads low enough so the low center of gravity permitted higher speed with safety and comfort to the passengers. In the ordinary motor truck chassis power plant reliability was of paramount importance, but if the engine vibrated at certain speeds or if it was somewhat noisy in operation, these conditions did not seriously militate against its use for hauling a moving van or coal wagon body. When the bus body was mounted, however, the situation was an entirely different one. Vibration and noise were detrimental to the passengers' comfort and therefore objectionable. The modern bus chassis must incorporate features of the passenger car as well as the truck. It must have more refinement of those details making for speedy and comfortable transportation, and at the same time it must have that ruggedness of construction to carry its loads safely that is associated with motor truck chassis design.



Typical bus specially adapted for non-stop inter-city runs or for sight seeing and touring

This has resulted in the development of special spring suspensions and the employment of giant pneumatic tires to secure maximum riding comfort. Bus bodies are sometimes carried by special resilient supports, either in the form of rubber pads or metal spring members attached to the chassis frame. One of the marked improvements of the past year has been the use of rubber shock absorbers or insulators at the spring ends to replace the usual hinged steel shackle with its spring eyes, bronze bushings, hardened and ground shackle pins, shackle bolts, nuts and grease cups. The natural ability of the rubber insulators to adjust themselves under pressure to constantly varying road conditions relieves the springs of all undue twisting strains so prevalent when the non-yielding shackles of metal are employed. Where these rubber shock insulators are used it might be said that the chassis frame, including power plant and transmission mechanism, floats upon eight insulators of live resilient rubber which act in effect as though the spring ends were supported by a sensitive though strong molded jelly. It is stated that a life of 100,000 miles is not at all uncommon in the case of the rubber shock insulators, and that when depreciation sets in but a few hours are needed to make a change or removal of the worn parts. These rubber insulators act to reduce vibration and are stated to result in increased tire mileage.



At the front a box container, at the rear a crate, each being adapted for certain specific types of merchandise

Loading two styles of unit containers on a single truck

Bus body construction has improved just as the design of the chassis has. Fortunately the engineers charged with bus design had ample previous practice to draw on, and in bus bodies one finds the best features of both the passenger automobile and the trolley or electric car. Drawings of typical bus bodies presented herewith show two types. The seating arrangement of the city type is such that considerable space is provided at the rear by using seats running fore and aft, so that grab stanchions and horizontal grab rails may be used by standers. This combination arrangement provides more standing room than the interior of the suburban type, which has only cross seats and which is particularly well adapted for suburban and inter-city routes. These bodies have window curtains, brass bar window guards for the exterior, roller destination signs and other features found in electric car bodies.

Radically different bus from the one pictured above, designed for city use where frequent passenger stops are made

Many railroad lines have lost so much of their passenger traffic to interurban trolleys and highway vehicles that their remaining patrons can be carried in much smaller units than the conventional locomotive and two-car train. Therefore short line officials are brought face to face with the fact that with rapidly mounting cost of service and decreasing numbers of passengers, it is now in the majority of cases no longer a question of showing a profit but rather of how much the operating losses can be reduced. They have accomplished wonders in the way of cutting expenses to the bone, but with steam equipment they are nevertheless waging a losing battle, because the cost of operating even the lightest two-car train is apt to be greater than the revenue from the few passengers carried. Gasoline propelled rail cars have shown that they can handle light passenger traffic satisfactorily and at much less expense than is possible with steam equipment. Rail cars are capable of providing clean, comfortable, safe and reasonably rapid passenger service, and can be operated for approximately one-quarter of the expense of steam equipment. They offer an opportunity of eliminating present operating losses, with a possibility of actually turning them into a profit. In addition to their marked ability to operate economically, these rails cars are instantly popular as a strictly modern conveyance designed for a specific purpose.

Single gasoline propelled rail cars, in addition to being a practical answer for such situations, are also ideal for operating in new, undeveloped sections that must await the time when traffic will warrant the installation of heavier equipment. Because the capacity is limited to the requirements of a special type of passenger traffic, they can be built lighter than equipment designed for heavy, long-distance loads. This lightness, coupled with the fact that the speed does not exceed 40 miles per hour, permits the use of moderate power—and moderate power means moderate costs. Where the traffic is too heavy to be carried on one car, it is frequently practical to run two cars and at the same time give the public the advantage of a more attractive schedule at an operating cost that does not exceed half that of a single steam train.

Where the usual train is composed of separate pulling and trailing units, great weight of the pulling unit (which carries no useful load) is necessary to secure traction, and correspondingly a husky construction is essential in each part in order that it may withstand the shocks of coupling. In the rail car all of the useful load contributes directly to the traction for both driving and braking, permitting a corresponding reduction in the dead weight. This advantage, in addition to a total absence of coupler impact, plus the use of anti-friction ball and roller bearings, alloy steels, aluminum and pressed steel sections, assures heavy duty characteristics with the economy of light weight. The rail car is not a motor truck. Nevertheless in its construction are employed many principles of engineering and mechanical parts which are the result of highway transport development.

Space is not available to describe the many structural features of rail cars, but suffice it to say that many of the components, especially the power plant and transmission, are modified from similar components of motor trucks. The engines are similar to truck engines and

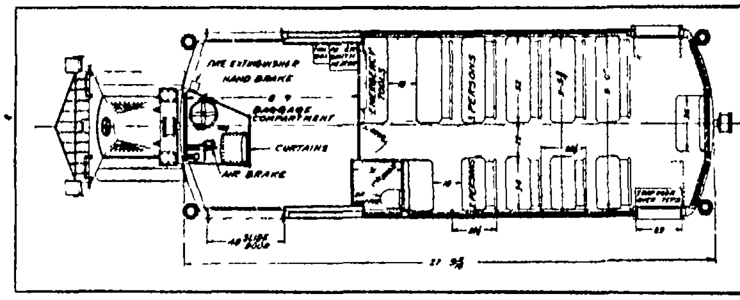
In the Mack A C the bore is 5 inches and stroke 6 inches of the regular four cylinder type A single-plate clutch and a main four speed transmission of the selective type are used Between the engine and the main transmission is an auxiliary reverse transmission which serves to change the direction of rotation of the drive shaft when it is desired to reverse the car This provides as many reverse speeds as there are forward speeds available When operating the car in a forward direction this auxiliary reverse transmission is idle

It is in the chassis and axle details that the rail cars differ most from motor trucks The Mack A C and A B rail cars are six wheel designs the front of the chassis being supported by a four wheel truck similar to those used in railroad practice The Mack A B and A C X models are eight wheel designs both front and rear being supported by four wheels Figures show that the cost of operation of the A B model which has a four cylinder engine of 4½ inch bore by 5 inch stroke and which is lighter and of less capacity than the A C types is about 23 cents per car mile with a one man crew while the larger car with a two man crew costs about 30 cents per car mile The smaller car may carry as high as 30 persons and as the rate can be three to four cents per mile per passenger and even more, it will be seen that a profit is easily returned even if the car does not carry its full capacity on all trips The A C car may have seating arrangements for 16 persons if no baggage compartment is provided so its profitable operation is only a question of proper scheduling to insure full passenger loads The larger car has a speed of about 40 miles per hour on the level and will climb a 4 per cent grade at ten miles per hour The A B car has a maximum of 28 miles per hour on the level and will climb a 4 per cent grade at seven miles per hour The acceleration of the more powerful car is to 30 miles per hour in 61 seconds the smaller can attain a speed of 25 miles per hour in one minute s time The deceleration is the same on both models or two miles per hour per second

The rear axle is similar to an automobile axle of the full floating type It consists of a cast steel housing with forged steel extensions inclosing the driving gears and axle shafts The drive is transmitted by a single set of large bevel gears driving without a differential through splined axle shafts which in turn are splined into the combination hub caps and driving plates on the outside of the wheels The wheels are steel castings with shrunk on tires They are separate from the hubs being bolted in place Two long semi elliptic springs are bolted directly to the rear axle just inside the wheels which support the frame These like the leading truck springs are equipped with rubber shock insulators at their tips The shock insulator consists of a cast steel box riveted to the frame which receives the tip of the spring between blocks of rubber Pressed steel cups are riveted to the spring tips which fit the inner ends of the blocks The elongation and shortening of the springs due to their deflection is thus taken care of by the kneading action of the rubber This eliminates much of the friction and therefore the need of lubrication at these points and furthermore provides a cushion to absorb all of the minor shocks and vibrations insulating the frame from the springs

The four wheeled leading truck supports the front end of the car through two long semi elliptic leaf springs These springs are set longitudinally and seated on a heavy cast steel body bolster This body bolster is pivoted to a cast steel swing bolster which is slung under the leading truck frame by links and extended to form side bearings for the body bolster The leading truck frame is made of pressed chrome-nickel channel steel like the chassis frame the various fittings being drop-forgings and steel castings Axles are fixed being made of chrome vanadium steel The wheels which are steel drop-forgings turn on tapered roller bearings The frame side-members are heat treated chrome nickel steel pressed into shape All holes in the frame are drilled (not punched) and all frame members brackets etc are hot riveted All steps grab-handles, etc are made in accordance with the latest requirements of the Interstate Commerce Commission

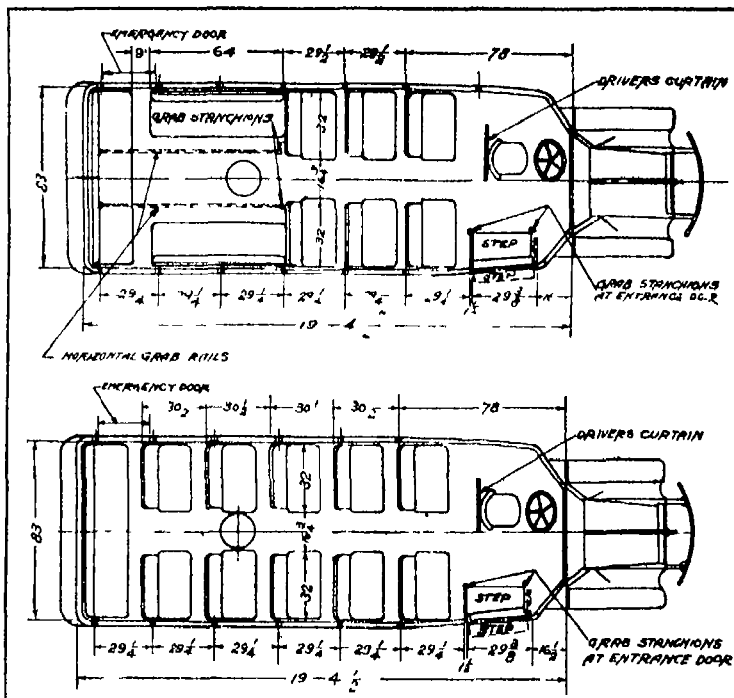
The air brakes embody a compressor equipped with an unloader and driven off the four speed transmission countershaft, compressing the air in two large-capacity tanks fastened to the chassis frame The air-control valve is operated from the driver s seat and applies the brake shoes on all wheels simultaneously A large serviceable air-gage is mounted on the dash in front of the operator A hand brake staff with a standard non-slipping rubber wheel, together with a ratchet and pawl, is provided at the front end of the car This staff applies the brake shoes on the rear wheels and is used for emergency purposes or for holding the car on a grade overnight



Ground plan of a typical eight-wheeled rail car

Unit containers usually thought of as individual boxes which can be loaded and sealed by the shipper transported to the consignee on truck chassis freight car boat or all three without disturbing the contents offer great possibilities in the coordination of all transportation facilities and the expediting of freight movement The outstanding instances of unit container use in this country are to be found at Cincinnati Ohio and on the New York Central Railroad lines

The demountable body in various forms is in use to a limited degree in many parts of the country and is probably more adaptable for general purposes of motor truck cartage than the unit container In other words, we can say that the unit container is commonly referred to in connection with traffic interchange between rail and road vehicles whereas what we usually term a demountable body or flat is more often used simply for interchange between motor truck and loading platform As a matter of fact to all intents and purposes a unit container is a demountable body when used with a motor truck and a demountable body or flat can easily be used in an ordinary flat-car on rail movement The container-car however is one fitted to accommodate a definite size and definite type of container and is not intended to be used with any other equipment.



Referring to the photographs of page 11 the upper of these drawings shows the city type with seating accommodations subordinated to sheer carrying capacity the lower represents the suburban or inter-city type in which the aim is to provide each passenger with a seat

Two types of seating arrangements for bus bodies

The practicability of the unit container has already been proved by experimentation in both this country and in Europe The unit container known as the "Lyons' type is the best and most up to date type Its unladen weight is only two-fifths that of an oak container of equal capacity It is constructed of duralumin, a material similar to that used in the German Zeppelins The New York Central type of container was designed primarily as a unit that would fit a special flat-car but of a weight and size easily adaptable to the conventional motor truck chassis equipped either with or without a body

Other types of unit containers are glass-lined tanks such as are used on the New York Central lines, and adaptable for milk and other liquids that can be shipped in bulk, while containers for household goods tobacco products, confectionery and other commodities carrying a high tariff are in use in various parts of this country and Europe in a very limited way One of the greatest advantages of a flat or demountable body recently developed is that it can be transferred to the truck chassis either from the ground or the loading platform with equal facility by power derived from the truck engine, and in addition can be hauled on and off an electric or steam railway flat-car by the same method Moreover, in effecting the transfer no overhead cranes are necessary, which means economy in cost of operation and space used at warehouse and at

(Continued on page 68)

Something New in Automobile Drives

SOMETHING decidedly new and surprising has been sprung on automotive engineers of Great Britain by Mr G Constantinesco who will be recalled as the inventor of the wave power method of transmission described in these columns several years back Mr Constantinesco s latest surprise is an automatic variable gear or torque converter as he terms it, torque being best described for the non technical reader as "turning effort" It is probably the most revolutionary device yet introduced into the evolution of the automobile, since it renders unnecessary the clutch, the transmission gears, and the usual rear axle drive of which the transmission is easily the most backward feature in the modern car

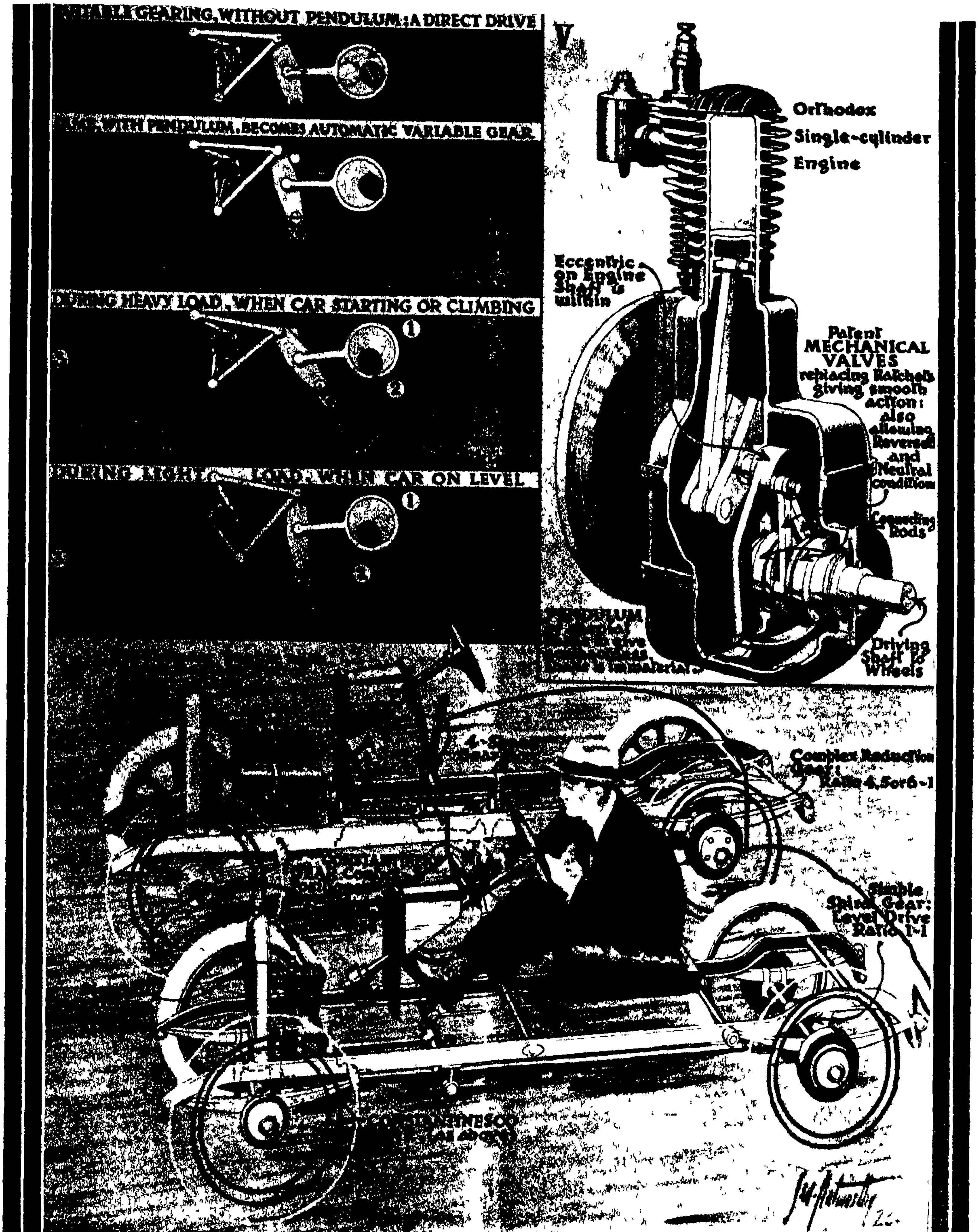
The essential feature of Mr Constantinesco s invention as shown in Figs I and II on the facing page is a pendulum introduced between driving shaft and driven shaft which perpetually adjusts the engine output to the load, or the varying resistance of the wheels.

All pendulums have a "natural" rate of oscillation and interference with this sets up the reaction on which the invention depends the free swings become, as it were arrested side-to-side jerks, or unduly prolonged thrusts Its action is explained in Figs III and IV The device is not so difficult to understand Common sense suggests that the engine would merely waste its power in a futile wagging of the pendulum instead of which the reaction actually accumulates or stores energy in exact proportion to any increased resistance by the driven shaft

Fig V shows Mr Constantinesco s first design for an automobile engine unit and demonstrates how neatly it can be incorporated Fig VI shows the striking difference between the resulting chassis and a normal example of equal capacity with which it is compared The big power of the latter's engine is required only at the rare intervals of starting and climbing, and is wasteful at all other periods.

Control is simplified the motorist, at starting, merely sets the gear lever from "neutral" to "forward" and forthwith forgets there ever was such a nuisance as three-speed transmission The special "Mechanical valves" seen in Fig V, at present secret for patent considerations, render the action quite smooth and noiseless, entirely eliminating the jerks which usually accompany gear-changing, and allow of rapid reversals even under full load

In a recent demonstration a drive of this kind operated a motor truck with but a 10-horsepower engine instead of the usual 20-horsepower engine, carrying ten men and towing a four-ton trailer



Drawn by our British staff artist, S. W. Clatworthy Copyright, U S A

DRIVING THE MOTOR CAR WITH A PENDULUM: THE LATEST SURPRISE OF THE INGENIOUS INVENTOR CONSTANTINESCO OF WAVE POWER FAME—(See facing page for description)

Our Point of View

REVIEW OF THE YEAR, 1923

Civil Engineering

IT IS our custom in this review to treat civil engineering by itself covering the progress in mechanical engineering under the various divisions of the broad field which it covers. In civil engineering progress has been confined to the carrying on for the most part of works already in hand and as usual it has been concerned mainly with water supply irrigation and the permanent works needed for the enlargement of transportation facilities. Gratifying progress has been made on the Hudson River vehicular tunnel the first venture of this kind on so large a scale. Work also has been started on a freight and passenger tunnel beneath the Narrows in New York Harbor. The Panama Canal thanks to the huge shipments of oil from California is showing a remarkable increase in traffic; we wish that a similar growth could be recorded for that great waterway the New York State Barge Canal which is suffering from its long disuse during reconstruction. Shippers seem to forget that the parent Erie Canal whose centenary was celebrated last year was the principal agency in the early growth of the Port of New York. Of new railroads construction there has been practically none; the engineer has been occupied in adding tracks to existing roads rather than building new ones. There is an increasing demand for water supply and irrigation. Rapid progress has been made on the Schoharie Dam in the Catskill Mountains and two additional pipe lines each eleven feet in diameter are being laid along the lines of the Catskill aqueduct by which an additional 250,000,000 gallons of water per day will be available for New York City. The Shandaken Tunnel eighteen miles in length for conducting the Schoharie water into the Ashokan reservoir was completed during the year. Of large bridges that across the Hudson at New York is awaiting favorable action by the War Department and work has commenced upon a great highway suspension bridge across the Hudson at Bear Mountain which will have a main span of 1632 feet. Although the proposed crossing of San Francisco Bay which will call for one of the world's greatest bridge structures is still in the preliminary stages undoubtedly this work will be put through, so necessary is it to the convenience and local development of San Francisco and its various great suburbs across the Bay. Reinforced concrete bridges are being built in increasing numbers and of increasing size. The low cost speed of construction and architectural beauty of this type of bridge are bringing it into increasing use. Among notable examples of concrete bridges we have recorded and illustrated the handsome Georgetown arch bridge at Washington the concrete-covered steel arch bridge of 300 feet span across the Willamette River at Oregon City the rebuilding in concrete of the great Harrisburg bridge and the construction of the very beautiful bridge between Detroit and Belle Isle with its many graceful elliptical arches.

Pure Science

As usual the quiet current of the year's doings in this field concerns itself with the investigation of the physics of the atom and as a result of the work done during 1923 we are appreciably closer to a clear understanding of the bond between electricity and matter the electrical and spatial properties of electron proton and atom and in general the nature of things. Extremely valuable is the work as yet unpublished in connection with the hitherto-imperfectly understood spectral lines of the elements. We appear to have a rock ribbed mathematical formulation of the location of these in terms of other numerical properties of the atom and while as yet the matter remains on this strictly empirical basis with no hint of the underlying mechanism of cause the latter will doubtless follow—and even should it not a complete empirical formulation is of itself a tremendous gain.

If the quiet current of orderly scientific progress remains undisturbed in its direction for 1923, as compared with previous years there has been at least one occasion on which the stream has overflowed its banks at an unexpected point. The Japanese earthquake has brought about a great revival of interest in seismology geology and the allied sciences with the eminently practical aim in view of enabling us to forecast there probable occurrence of such catastrophes and there seems ground for asserting that sufficient new light on the underlying causes of the earth's uneasiness has been obtained to lead to the hope that the aim may be in part realized.

Psychic Research

For the first time we dignify this branch of science with separate consideration under a formal heading of its own. It is one in which progress is necessarily slow because of the dearth of experimental material. Good mediums are scarce and good mediums who have the temperament enabling them to work profitably for scientific investigators are even rarer. But there appear to be a few of these, and with them the collation of data proceeds—it would of course be extremely rash to advance any claim that the investigation of psychic phenomena has proceeded beyond this stage.

Our own investigation has to date been disappointing in that no genuine manifestations have been brought before our committee. Other workers have been more fortunate and in Great Britain the body of investigators working with the medium Stella C has had the singular good fortune of being able to prove categorically the existence of a manifestation that has been freely disputed—the cooling influence of the mediumistic trance upon the immediate neighborhood. Seances have been held in a locked and sealed room sufficiently insulated against all influencing of the temperature from without. Obviously under the operation of known causes the only thing that can happen to the room temperature is a slight rise from the heat radiation and combustion products of the numerous persons present. Actually this did occur in the end the temperature at the close would always be slightly higher than at the beginning. But the verdict of the sitters' senses that the room was materially cooler during the mid portions of the seance was checked up by self recording thermometers and found to be in accordance with the facts. This cooling was always appreciable; in two or three instances the bottom of the temperature curve, corresponding with the climax of the trance and the other phenomena was no less than twenty degrees Fahrenheit below the initial figure. There seems no escaping the conclusion that we have here a genuine psychic phenomenon—that the medium in some way absorbs large quantities of energy from the surroundings, giving it back later on. By no possibility can the conclusion be avoided that this iron clad series of observations is the event of the year in psychic science.

Our Abrams Investigation

During the past year the SCIENTIFIC AMERICAN has found it necessary to engage in another investigation, this time of the electronic reactions of Abrams method of diagnosis and treatment of disease which has attracted world wide attention and has caused one of the bitterest controversies yet waged in medical circles.

That a drop of blood gives off certain emanations and that these emanations when properly gathered tuned in and led to the delicate nerve centers of a healthy human being will cause certain reactions and that these reactions enable a 75 to 90 per cent accurate diagnosis of the past present and future health of the person from whom the drop of blood was taken is the basic claim made by Dr Albert Abrams of San Francisco the discoverer and dean of the E R A technique.

Taken at its face value and considered in the light of present day science E R A technique is fantastic and irrelevant. Nevertheless the wide application of this method the thousands of doctors who are now using it the public's interest in the work of Dr Abrams and other important factors make it becoming in the SCIENTIFIC AMERICAN to conduct a thorough and far reaching investigation so that the truth may be found and made known.

Radio Communication

Radio communication has maintained its unrelenting march of progress during the past twelve months. Not only have there been marked advances in the popularized form of radio known as broadcasting but also in the serious vitally important, workaday ship-to-shore and shore-to-shore communication which goes on steadily without attracting much attention.

In everyday radio communication the past year has been marked by an increase in the number of high power stations proving again that radio is firmly established in the commercial world as a means of rapid and dependable communication. Then, too there have been various innovations by way of improved codes and automatic transmitters and receivers having for their object the speeding up of radio traffic. These are radio's answer to the challenge of the cable companies which have also engaged in speeding up their traffic by improved cable design and equipment.

Some progress has been made in the battle with the arch enemy of radio—static—the "noises of space" which at times interfere seriously with the handling of radio business. Other problems also have received their due share of attention during the year just closed.

But it is in radio broadcasting that the marked progress has been made. Looked upon as a fad in the beginning radio broadcasting has now intrenched itself pretty firmly in the routine of American life. This is due to the commendable efforts of the broadcasters who during the past twelve months have been steadily improving their programs. Radio engineers have given us better and better acoustics until today the radio music is quite on a par with the best phonographic reproduction. The Government has given a hand by way of new legislation which has served to clarify the wave-length muddle under which radio broadcasting labored at the beginning of the past year. Then too, the number of broadcasting stations which reached the high water mark in excess of 800 last June has been steadily declining ever since making for better radio broadcasting through the elimination of much unnecessary interference.

At the receiving end the work of the engineers has been very much in evidence. Better vacuum tubes have been introduced as well as better transformers to provide better music from better loud speakers. New circuits have made their appearance causing many of the old circuits to become obsolete. Most important of all however the radio industry has introduced the radio receiving set in the form of a true household article by enclosing the set in an attractive cabinet, making it entirely self-contained and removing all traces of radio. Thus the radio receiving set of this kind known as the "furniture radio," has been brought into the finest of living rooms there to take its permanent place beside the piano and the phonograph. That is the significant thing in the radio history of 1923.

Railroads

Although as noted above, there has been practically no new railroad construction there has been as great activity as limited funds permit in the construction of additional tracks on congested stretches of roads and in recovering all roadbeds and track from the sad state of deterioration into which they had fallen during their administration by the United States Government. Great credit is due to the railroad executives for the vast economies they have achieved, and the substantial betterments which they have been able to make in the face of lower rates and general labor troubles. For the first time in many years the total length of track in the country has fallen below 250,000 miles. In June 1913, the United States possessed 253,470 miles of

Our Point of View

track on December 31 1916 there were 259 705 miles but at the beginning of 1923 there were only 249 231 miles of single track The hard times which the rail roads are passing through is demonstrated by a com parison of the number of cars and locomotives built Cars and locomotives wear out they must be replaced quickly and continuously In 1898, 2 475 new locomo tives were built in 1906 6,952 and in 1913 5 332, whereas in 1922 only 1 303 locomotives were built Again in 1914 3 691 new passenger cars were added to the equipment, in 1922 only 747 In 1913 207 684 new freight cars were built and in 1922 only 66 747 These figures show the futility of a further reduction of freight rates In railroad cars there is continuous sub stitution of steel for wood Locomotives have appar ently reached the limit of size, but there is considerable activity in the development of new types designed to equal the work of the steam locomotive on a smaller consumption of fuel Notable among these is a con densing turbine locomotive built for the Swedish rail roads which in competition with steam locomotives, hauling express trains of the same weight, has reduced the coal consumption by 50 per cent

Automobile and Motor Truck

In both the automobile and the motor truck we have the most perfect mechanical device of the present day The automobile in its passenger carrying capacity in proportion to its weight its low consumption of fuel its reliability and general comfort stands far in the lead of any modern means of travel The same high praise may be justly given to the motor truck in its own particular field of work. The improvements of the future are foreshadowed in such devices as the four-wheel brake and the preheating of the charge, both of which in their limited application have given excellent results To render the automobile absolutely perfect there should be developed some automatic method of varying the richness of the mixture to meet the changing conditions of load and some genius should develop a substitute for the present shifting gears, or what is sometimes called a gearless gearing In spite of the enormous number of cars the automobile industry continues to grow by leaps and bounds In evitably this has brought serious problems of traffic control in our cities and even on our highways The automobile interests realizing this should lend every possible assistance in the development of the best work able plans for traffic control The time approaches (indeed it has already arrived) when Federal laws for the control of highway traffic should be set in force Legislation of this kind is a natural corollary to Federal aid in the construction of highways We need unified laws that will apply everywhere throughout the United States The rapid growth of the automobile industry in this country is shown by the fact that at the present writing we have about 12 500 000 cars in the United States and over 1,000 000 in New York State alone

Merchant Marine

The year 1923 has failed to bring about that revival in shipping affairs which the world so greatly needs. The continued stagnation is due largely to the unsettled conditions in Europe Until the problems of that con tinent are settled and industrial activity returns to something like normal shipping will remain more or less in its present stagnant condition Our own prob lem revolves around the Shipping Board and the close of the year finds us apparently as far from a satisfac tory settlement as we were at its beginning The con sensus of opinion among our experienced shipping men is that the Shipping Board should be dissolved, and that the Government ships should be sold outright or turned over to private operators It begins to look as though this would be the solution ultimately adopted The event of the year in the United States was the going into commission of the "Leviathan" and the excel lent showing which it is making in the Atlantic service On her last trip from Cherbourg to New York she cap tured the record by making the run in five days seven hours and twenty minutes with an average speed of 24 17 knots her longest day's run being 617 knots In the Leviathan and 'Majestic of 61 100 and 61 800 tons displacement, we have reached a size which prob ably will not be exceeded for many years to come The serious problem of dock accommodations will tend to keep down the size and the future ocean going passen ger ships will be contented with a maximum displace ment of about 35 000 tons and a speed of about eighteen knots *As regards new construction the most notable* fact is the steady increase in the relative number of Diesel engined as compared with steam driven ships There are several varieties of Diesel engines on the market or in course of experimental development and of these the Still engine which makes a combined use of gas and steam is the most interesting and original The two cycle engine is being very fully exploited and the probabilities are that within a few years the inter nal combustion engine will have shown such an all around superiority that it will have complete possession of the field except in ships designed for special lines of service

Naval and Military

The outstanding event during the year in Naval affairs was the signing by France of the Washington Treaty for the Limitation of Naval Armaments thus rendering this epoch making compact effective All the nations concerned have now either destroyed or are engaged in breaking up the ships whose removal is called for by that treaty Its beneficial effects are seen in the perfect quiet which has taken the place of the angry storm which threatened to break forth in the Pacific Encouraged by this success the United States should now call the nations of Europe together with a proposal for a similar reduction of land armaments We insured the success of the Washington Conference by our own large contribution to the reduction of naval equipment If we approach Europe in the same spirit we believe that Europe would make a quick response This might take the form of a promise to ease the financial burdens of the European nations on the condition that they will cut down their armies stabilize their currencies and balance their budgets The reduction of armies to a reasonable figure would relieve these nations at once of a heavy burden of expense and the combined effect might well lead to an early and satisfactory settlement of the reparations problem Naval ship construction has been confined to the building and completion of such vessels as were permitted by the Washington Treaty Great Britain has two such ships on hand and during the year we have put in commission the Colorado and practically completed the West Vir ginia" These two ships with the Maryland consti tute the three largest and most powerful battleships afloat The Naval Treaty took no account of unarmed ships, and the United States Navy is relatively weak in cruisers The country should urge upon Congress the construction of the 10 000 ton cruisers recommended by the General Board of the Navy Without them our fleet is badly out of balance Several of our fast 34 knot 7500-ton scout cruisers have been commissioned during the year and all of them have exceeded their contract speed During the year the Army Bureau of Ordnance has done notable work in the development of new types of guns of great power range and flexi bility that are superior to any existing types abroad Equally good results have been achieved in the devel opment of military tractors and motorized artillery

Aeronautics

The brilliant achievements of the Army the Navy and a few of our private firms in the field of aeronautics is at once a great credit to the nation and a standing rebuke to the parsimony and indifference which Con gress has shown to the development of this new art The close of 1923 found this country in the possession of nearly all of the records for flight The Naval Air Service in winning the Pulitzer prize placed this country far in the lead by maintaining an average of 243 67 miles an hour over a triangular course of 200 kilometers with a Navy Curtiss racer and this is only one of a series of records which have given this country its unmistakable lead in International competition The Transcontinental Air Mail Service has achieved remark able results by introducing a continuous night and day service between New York and San Francisco On August 23rd the mail was brought from San Francisco *to Mineola N Y in twenty six hours, fourteen minutes* On the following day another batch of mail arrived in twenty six hours seventeen minutes Equally gratifying has been the performance of our first dirigible of the Zeppelin type the Shenandoah built by the Navy and flown by the Naval Air Service in a series of long dis tance flights every one of which has been completed without mishap This ship has proved to be in every respect a great success It marks a new era as being the first Zeppelin to be entirely filled with helium gas. The very successful airplane meet carried out late in the year by the Army Air Service at Mineola was a revelation to the public of the great advance which has been made in speed and controlability of the latest types of machines built for Army service Nevertheless in spite of this brilliant work to which a few patriotic private firms have so greatly contributed as designers and builders of airplanes the Government of the country is showing a lack of appreciation that is posi tively astounding Congress has failed in spite of urgent appeals to take any steps towards the passing of those laws for the regulation of flying which are so urgently needed both for the encouragement of aviators and for the protection of the lives of the pilots, the passengers and the public at large

Electricity

One of the great problems in the electrical world today is that of developing the latent waterpowers of the country through a comprehensive and thoroughly co ordinated scheme which will develop the maximum amount of power with a maximum possible distribution at a reasonably low cost For some years there has been presented for consideration what is known as the Super Power scheme which covers the leading manu facturing section of the country lying between Canada and Washington and reaching from the Atlantic coast to the Allegheny Mountains This plan if carried out will develop the waterpower of the St Lawrence River of Niagara and of the other lesser streams and rivers will establish large central power stations in the neigh borhood of the various coal fields and will gather into one great consolidation the present widely scattered private hydro-electric and steam electric powerplants It will feed the aggregate power thus secured into one great system of distribution from which the users will draw their power as and where it is required The economy thus secured represents the annual saving of over 50 000 000 tons of coal The transmission line problems have grown with the stretching process and they have come in for a large share of the researcher's attention The past year has been marked by a con tinuation of the million volt experiments of the preced ing year with the result that aside from the spectac *ular much practical information has been gained*

Interesting progress has been made with carrier cur rent telephony and carrier current control By means of a carrier current it has been possible to telephone over high power transmission lines over street-car trolley wires and tracks and over lighting circuits The past year has witnessed the introduction of carrier current telephony over long distance transmission lines for ensuring communication between the main gener ating station and sub stations and also over lighting systems for the purpose of bringing wired wireless music and talks into the home of electric light con sumers Also it has been demonstrated that carrier current can be employed for controlling operations at a distance

Our Abrams Investigation—IV

Odds and Ends Gathered from an Avalanche of Correspondence and Several Interviews

By Austin C. Lescarboura

Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

THE truth or the falsity of the claims made for the Electronic Reactions of Abrams Technique otherwise known as E. R. A. for short, will never be settled by argument, so far as the thinking public is concerned. Despite tons upon tons of literature despite thousands upon thousands of testimonials of wonderful cures despite bitter attacks on E. R. A. based on superficial examination of the claims and upon an incomplete study of the technique itself on the one hand, and laudatory articles based on blissful ignorance of the limitations of the technique on the other despite demonstration after demonstration made under conditions over which the investigators have little if any control the world still waits for clean-cut, positive and understandable evidence based on rigid impartial yet thoroughly convincing tests.

The burden of proof is on those who claim that a new reaction producing energy has been discovered and harnessed. We are told by Dr. Albert Abrams of San Francisco the originator of this new technique of diagnosis and treatment that by securing a specimen of human blood the size of a nickel on a piece of white blotting paper and then placing this blotting paper in an electronic circuit so called, properly grounded and including in its path a healthy human being the electronic diagnostician can by "percussing" the abdomen of the human being or "reagent" determine the sex the condition of health the diseases present if any and the potentiality and location of the diseases or infections in the body of the person from whom the blood specimen was originally taken. It will be noted that this is a diagnosis by proxy so to speak although the patient himself or herself can be diagnosed in person if preferred.

The claims are fantastic. Everyone admits as much. They are certainly not in accord with standard electrical practice although wires, rheostats resistance windings ground plates and other paraphernalia strongly suggestive of electrical equipment are employed and electrical terms such as ohms are freely used. The claims are far removed from orthodox medical science. Indeed Abrams announces in no uncertain terms that orthodox medicine is bankrupt at this very moment! The claims baffle the scientist. he is either bound to say that a drop of blood cannot give off emanations which will tell everything about the person from whom it was taken including even an infection under a certain tooth and a statement of the religion and the racial strains if need be or he is simply bewildered as when he sees the clever conjurer pull out a pair of rabbits from a perfectly proper silk hat. He is far from convinced of the validity of the claims but at least, he cannot say just how it is done.

It seems strange that these emanations of the human blood and of drugs and of diseased tissue should have escaped the attention of prominent scientists throughout the world. So much work has already been done on the electronic theory that surely this phase should long ago have come in for its due share of attention. It deals with human life itself than which there is nothing more important. Then, too it seems strange that these electronic reactions should be detected and classified by means of relatively crude rheostats which upon laboratory test often prove inaccurate so far as their electrical values are concerned. Yet the diagnosis is based on ohmage not only for the identification of the diseases but also for the degree of affliction.

Let us see what the claims are for this E. R. A. technique. They may be summed up as follows:

1 All substances give off radiant energy. Unfortunately several substances may give off the same kind of energy which complicates the matter.

2 The energy from the blood of an individual represents all the attributes of that individual, including his disease processes.

3 Each disease and attribute gives off its own peculiar kind of energy.

4 These energies can be transmitted by metallic conductors, can be differentiated from each other by means of coils of wire having different degrees of resistance, and the potentiality of each energy can be estimated by arbitrary units of measurements.

5 Each of these energies when conducted to a living human subject known as the reagent, causes definite reactions that identify the energy.

6 The reactions have to do with slight changes in the tone of some of the hollow organs of the body, or at least a change that can be detected by delicate percussing by rubbing the superimposed surface of the body with a glass or hard rubber rod, or by a difference of texture of the skin as detected by the fingers and at times by a change in color of the skin over the organs in which the reaction takes place.

7 These energies are of a vibratory character and each disease has its own particular vibration.

8 Certain drugs have a similar vibration to certain diseases and therefore those drugs have a destructive action on the diseases to which they correspond, in accord with well known physical laws.

9 An instrument called the Oscilloclast, or "wave smasher," has been devised by Abrams and it is claimed by him that this apparatus develops a form of energy having a range of vibratory rates similar to the range of rates inherent in the different diseases of the body.

These are the basic claims made for E. R. A. From time to time Dr. Abrams and his co-workers have made other claims of a still more startling nature, such as determining the religion and nationality from the blood specimen, measuring by means of ohmage readings, the distance between the blood specimen and the person from whom it was taken, the diagnosing of a patient by means of his photograph which is said to serve in place of the blood specimen, and the diagnosing of such psychological phenomena as love, fear, deception, and so on. Whether these additional claims are to be taken seriously or not we do not know. Some of them have undoubtedly done untold harm to the E. R. A. cause, inasmuch as they have been turned into powerful ammunition by the attackers of this electronic technique. Indeed, we have been asked by some of the leading E. R. A. men not to take these additional claims seriously, inasmuch as they were merely experiments and mere diversions, engaged in by Dr. Abrams and his students in the San Francisco clinic, as an offset to the serious and rather tedious routine of diagnosing blood specimens hour after hour.

The blood specimen from the patient is placed in the dynamiser shown at the right. The emanations from the blood specimen are gathered and conducted to the healthy human subject or "reagent" who faces west by means of the "proximal" electrode. These emanations set up certain changes in the hollow organs of the reagent's body which may be detected by percussing as shown. The nature of the diseased condition of a patient represented by his blood specimen is determined by the "vibratory rate" which is obtained by the first resistance box known as the "vibratory rate" rheostat. The location of the diseased condition is determined by means of the second or "strain rate" rheostat. The potentiality of the disease is read off in ohms on the third or "measuring" rheostat. All resistances are connected in series. The patient is diagnosed by proxy so to speak

How the E. R. A. diagnosis is conducted with the usual blood specimen

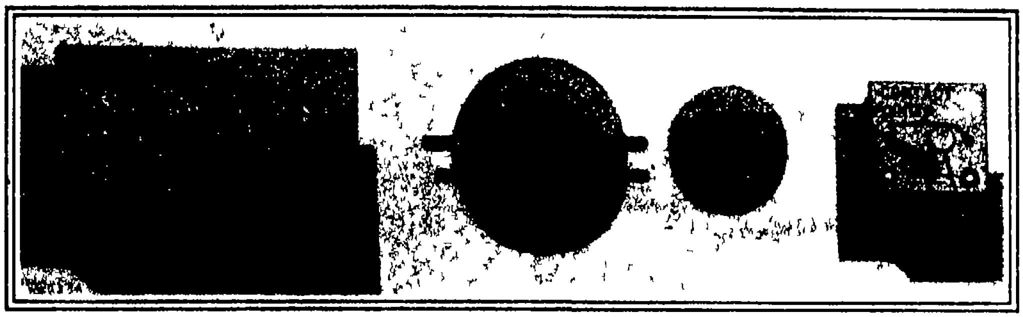
Now, when the SCIENTIFIC AMERICAN embarked on the difficult quest of investigating the validity of the claims of Dr. Abrams and the electronic technique as a whole, it was under the firm impression that the claims and the technique were definite and well established. For one thing the Abrams method of diagnosing and treatment is being used every day of the year. Next we had been given to understand that it took the place of orthodox medicine when the latter failed miserably. Then too, many M. D. practitioners have taken it up, after becoming convinced of its merits. Again, we had undergone an electronic diagnosis, and had heard our state of health reviewed with cocksure definiteness and dispatch, it was this, that and the other thing, with so much of each. It was a matter of precision, so it seemed, as compared with the relative uncertainties of the usual orthodox diagnosis. We had no way of determining how accurate the diagnosis might be. We were informed however, that the electronic diagnosis should run at least 75 per cent accurate, as compared with 40 per cent or less for the usual orthodox diagnosis. To which we can only add that these are not our figures, but those of the electronic reactions practitioners. And we are by no means obliged to accept them as final at this state of affairs.

Is it any wonder that the SCIENTIFIC AMERICAN felt that the basic claims of E. R. A. could be analyzed in short order? We were under the firm impression that any E. R. A. practitioner could give us a satisfactory demonstration, proving that the reactions took place in the delicate nerve centers of the human detector or reagent, and that these reactions, in connection with the diagnostic apparatus could serve to identify unknown blood samples, germs, and other things. In one of our informal calls on E. R. A. men we noted that the practitioner made use of tiny vials which were said to contain diseased tissue and germ cultures. These vials served to check up on the accuracy of the diagnostic apparatus, the reactions of the reagent, and the skill of the diagnostician.

As a starting point, we invited electronic practitioners to cooperate with us for we are investigating the electronic diagnosis and treatment technique as a whole, and not the individual practitioners. We have emphasized that point over and over again. Furthermore, in keeping with this policy, we have refrained from mentioning the names of those who cooperate with us feeling that the purposes of our investigation are better served if no names are given. And in confirmation of the wisdom of this policy, several E. R. A. men have already voiced their approval.

It is but fair that we mention here that so far only one electronic practitioner has come forward and cooperated with us in a test. This practitioner, whom we have called Dr. X, underwent a test to diagnose the contents of unknown pure-culture vials. A formal report of this test appeared in our November issue, and the results were far from convincing.

Meanwhile, no further tests have been made, much to our disappointment We have been promised tests and it does appear at this writing as though we shall have some real cooperation in the very near future. But from our first test to the present writing, little has been done except to listen to the criticisms of our first test on the one hand, and to reply to these criticisms by correspondence The E R A fraternity which is rather numerous, has been devoting no little time and effort to arousing a storm of protest on behalf of the practitioners and their patients who claim to have received very definite benefits from E R A. One E R A. association even went so far as to send out a form letter to practitioners, urging them to ask their satisfied patients to write to us, protesting against our methods of investigation, assuring us of the wonderful merits of E R A, and urging us to be fairer and wiser in our selection of cooperators



The Abrams Reflexophone shown at the left, consists of a resistance box with three multi point switches. The first switch introduces resistance in steps of ten ohms the second introduces resistance in single ohms and the third introduces resistance in 25ths of an ohm The three switches or rheostats are connected in series Usually three of the reflexophones are employed as shown on the facing page The center sketch shows the dynamizer with its adjustable electrodes and lid The electrodes are connected with the ground while the lid connection goes to the rheostatic dynamizer The right hand sketch shows the rheostatic dynamizer the function of which is to amplify the electronic energy

Three of the instruments employed in the electronic reactions of Abrams diagnosis

Unfortunately, we find it necessary, in view of the avalanche of mail that has poured into our office as the result of form letters, to enter into the personal side of an E. R. A. tangle, very much against our will We were not very long at work on this Abrams matter when we discovered the dissensions in the electronic ranks Externally, this new electronic technique appears to be one and indivisible, headed by Dr Abrams Internally however, we discover that the electronic technique is being broken up into several variations, with more or less adherents for each variation Thus there is the genuine E R A. technique, used in conjunction with apparatus approved by Dr Abrams and manufactured by a laboratory in which Dr Abrams is directly interested Then there is what appears to be the E R A technique making use of non Abrams apparatus which are referred to as "bootleg' apparatus in Dr Abrams own journal Lastly there are decidedly different electronic techniques which bear but a remote resemblance to the E. R. A., and which make use of as many different types of apparatus And needless to say there are as many shades of opinion as there are different techniques and apparatus and each camp insists that it has the very last word in electronic diagnosis and treatment and that all others are unscientific, inaccurate and more or less worthless

In explaining away the failure of Dr X the E. R A men have been rather unsportsmanlike, to say the least The main reason advanced for the failure of Dr X to make good in our first test of electronic technique, is that he is not an E R. A man and is therefore incompetent We have been accused of intentionally going to a non E R A practitioner Why go to a non E R A practitioner who uses non E R A apparatus, when you pretend to be investigating Dr Abrams? we have been asked

Again we say we are not interested in the personal side of this Abrams question We are interested in the blood emanations, in the little rheostat switches, in the delicate nerves of the reagent, in the electronic reactions, and in other phases which if they can be proved to be genuine, open an important field of research to the scientific world We care nothing about the opinions which electronic practitioners bear toward one another, and we have not set up our committee as an examining board to pass on the training of the various E R A practitioners

As to whether Dr X is a genuine E R A practitioner, it is not for us to decide We were under the impression when we undertook our test with Dr X that he was a genuine E R A practitioner We believed that he was using the Abrams method We saw the genuine Abrams apparatus in his laboratory although for our tests he made use of other apparatus which he claimed was more accurate We saw him using the Abrams "Atlas"—a loose-leaf book containing data regarding vibratory rates, percussing areas, and so on—in going about his work, when he found it necessary to diagnose for disease rates outside the usual routine

In reply to Dr Abrams' statement that Dr X is not a genuine E R A practitioner and is therefore unfit to cooperate with us in our investigation we take this opportunity of stating that Dr X has submitted documentary evidence which convinces us that (1) he was one of the original pioneer class that Dr Abrams taught in 1913 and then again in 1914 (2) that he conducted an experimental station for several years to test out the teachings of Abrams (3) that in the summer of 1922 he took up his third course in the Abrams technique, this time at the authorized college in Bradford, Pa, under Dr J W King the dean of that college, (4) that after he finished this last course Dr King ordered his diagnostic and treatment outfits directly from Dr Abrams, all of which constitutes what is presumably necessary to become an E R A practitioner Furthermore the documentary evidence indicates that Dr X not approving of the business methods which govern the rental and use of the genuine E R A equipment, decided to use other machines and to retain his independence in developing electronic technique

To quote Dr X, with regard to this matter There can be no other reason than the fact that I am not using the machines designed by him that gives him the excuse to say that I do not represent the genuine E R A methods To say the least I consider it most unkind and ungrateful of Dr Abrams to make such a statement when he knows to the contrary especially knowing as he does how, because of my unceasing devotion and loyalty to him and his work for the past ten years I have suffered all any pioneer of a new innovation could suffer Fighting as I still am for the same cause as he is I am astonished also at the apparent total absence of wisdom on his part in putting obstacles in my way

Having presented these facts we shall dismiss the Dr X and Dr Abrams controversy for nothing is to be served by our engaging in differences between electronic practitioners We are still interested in those blood emanations and the delicate reactions and the rheostat switches, nothing else Dr X has taken exception to our printed statement regarding the "Typhoid Mary" case which he has been treating An investigation of the various documents in this case reveals that we were substantially correct in our report of the facts hence we do not find ourselves called upon to publish more about this matter which is rather irrelevant to the general question under discussion Still one more point, Dr X wishes to make it clear that he undertook the test as an experiment because he had never before worked with pure germ cultures and that he did not expect the test to be reported We labored under the impression that we were making a definite test, rather than an experiment If there has been any misunderstanding in this connection we are very very sorry

Meanwhile why all this fuss about Dr X? The question is not so much whether Dr X is a genuine E R A or not but whether pure germ cultures can be identified Here we strike another of those controversial matters of which E R A seems so prolific We have been assured by some E R A men that pure germ cultures can be definitely identified, and by others that they cannot The preponderance of opinion seems to be that they cannot and we are about ready to set down as our first finding that pure germ cultures cannot at this state of the art be identified by means of the electronic reactions diagnosis Our first test pointed toward that decision and the mere fact that no other electronic diagnostician has come forward to undertake the same test which Dr X so willingly undertook, would serve to confirm it One E R A man in New York City has been working for several months with germ cultures, shielding them with lead foil and trying out various set ups of apparatus but at this writing his experiments have led to unsatisfactory results

It is well to remember that we invite all electronic practitioners to cooperate with us Time and again we are asked why we do not go to Dr Abrams Inasmuch as he is the foremost exponent of the electronic technique and is best qualified to give us convincing proof To which we hasten to add our full agreement with such views and suggestions Our investigation was no sooner announced than Dr Abrams wrote to us, offering to cooperate to the end that the truth might be made known to the scientific world We have gladly accepted this cooperation and we certainly appreciate it Through the kind offices of Dr Abrams we have received numerous pieces of literature regarding this subject which have served to give us a rather extensive background of knowledge so as better to direct our efforts

The suggestion has been advanced that we should send a representative to the laboratory of Dr Abrams in San Francisco Truth to tell Dr Abrams himself suggested our sending a man to his laboratory Were our investigation a mere matter of reporting interesting observations the idea would be gladly carried out for there would be no better story than that of Dr Abrams at work But inasmuch as this investigation is of a serious scientific nature aiming to arrive at the basic facts rather than to report mere impressions we firmly believe that a visit to Dr Abrams laboratory is of secondary importance at this time No doubt such a visit would serve to witness numerous startling demonstrations but it is well to bear in mind that demonstrations do not count as evidence in a scientific investigation Tests conducted under test conditions must constitute the necessary evidence on which a final and lasting verdict can be based

Some time ago we were favored with a visit of Dr Abrams personal representative during which the question of cooperation was discussed at length We suggested a number of simple tests which might be conducted at this time with Dr Abrams such as the forwarding of blood specimens to San Francisco to be diagnosed for us There are any number of blood tests which might be undertaken and which would disclose in short order the fundamental value of the electronic diagnosis And then day in and day out Dr Abrams is diagnosing blood specimens sent to him by his practitioners throughout the country

Please note that we are as anxious that the tests be fair as are the electronic practitioners We desire to obtain results We have not the time to make tests

(*Continued on page 69*)

DOES a drop of human blood give off emanations such as are given off by radio-active substances? Can these emanations be gathered and tuned in by means of a bank of resistance coils in series, and led to the sensitive nerves of a healthy human being where they cause certain changes or reactions? Are these reactions, assuming that they do take place a reliable indication of the passage of the blood emanations through the resistance coils? Is it possible by such means, to read the life history of a person like an open book, merely from a drop of blood? Has a new form of energy been discovered which contradicts established medical, electrical and in fact general science as it exists today?

Seeking answers to these questions, the SCIENTIFIC AMERICAN *has undertaken an investigation of the Electronic Reactions of Abrams method of diagnosis and treatment Positive proof of the validity of the claims made for this new technique is sought The cooperation of everyone is invited to the end that the truth may be learned and presented to the scientific world Scientific accuracy demands that the proof be irrefutable, and to that end a number of tests are to be conducted for the purpose of obtaining positive evidence* —THE EDITOR

Traffic and the Law

The Unnecessary Divergence Between the Motor Codes and Customs of the Several States

By the Scientific American Staff

IT'S AN old, old story but let's look at it again. There are 14 million automobiles and motor trucks in the United States. Just what does this mean to the man behind the wheel trying to get from Here to There in the least time and with the most comfort?

All told we have 2,800,000 miles of public roads. That makes five cars to every mile of road. But at least 90 per cent of the traffic is confined to 350,000 miles of paved road. For such highways the motor concentration jumps to 38 per mile. This would mean a spacing of 300 feet between vehicles and if Mr. Average Driver maintains a 20-mile pace, he would pass an approaching car every five seconds. Cut the figures in half if you will, to take account of the fact that all the cars and trucks are never on the road at once; agree that the remaining estimate applies only to certain hours—the situation is still severe enough. The failure of the quoted average to be realized in ordinary open road driving is met by its terrific inadequacy to represent the congestion of the city streets.

Such impressive averages make specific instances more or less superfluous. But the fact deserves mention that at the height of the Sunday evening crush many of the leading highways entering New York City are filled with solid traffic lines for forty or even sixty miles out. Approaching the city from the west, one sometimes meets the standing ferry lines at a distance of four miles from the river. A parallel situation exists around all our big cities, while in their actual streets the jam at the busiest hours beggars description. At the main corner in Newark, and for six long and weary blocks through the heart of Los Angeles, *all* turning in or out of the main street, right hand as well as left hand, has had to be prohibited.

The problems arising out of this fearful volume of automobiles fall broadly into two categories. There is the issue of making the highways safe—an inordinate number of people, in and out of the offending vehicles, is killed every year through the agency of automobiles. And there is the issue of making the highways expeditious—it takes longer and costs more to move from point to point over our roads than it should.

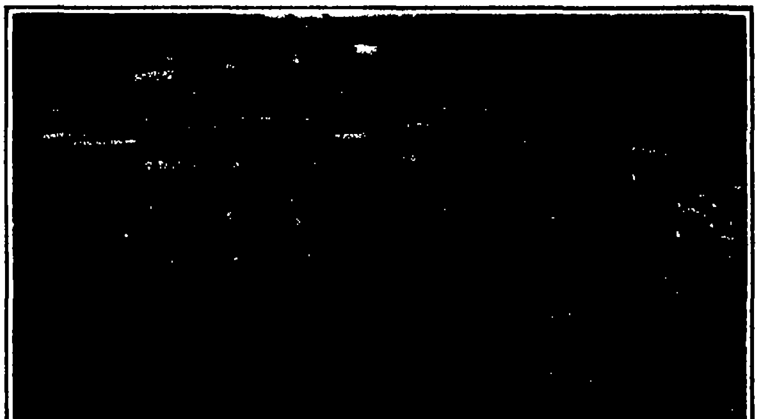
The problem of safety presents two major angles—the regulatory one and the physical one. On the broadest, flattest and straightest highway imaginable, with perfect pavement, accidents will occur in the absence of supervision of some sort. And on poorly paved roads, with narrow bridges, blind crossings, sharp corners and excessive grades, accidents will happen in spite of the most complete system of traffic rules and the most careful observation of the law. We must have safe highways sanely used before we shall bring down the accident total to the irreducible minimum.

In exactly the same fashion the problem of making the use of the highways expeditious divides into two. In the absence of proper regulation of points where streams of traffic meet or where congestion arises from other causes or where the road hog is tempted to do his worst, we will necessarily have traffic tangles which cause annoyance and delay, regardless of how well our roads are laid out. And regardless of how well we regulate traffic at the critical points, if the physical relation between the highway, the railroad, the grades and turns, the cities and towns traversed, etc., etc., is not what it should be, we cannot keep the cars flowing smoothly and expeditiously.

In the present article we shall have little to say of the physical problems of making the roads safe and making them swift beyond this mere pointing out of the existence of the problem and its place in the general scheme of automotive philosophy. For important as it is to have the physical characteristics of the roads correct, very many of the existing roads are wrong in numerous fundamentals. Very many existing laws are wrong too, but the changing of a law is, on the whole, a somewhat simpler, and certainly a less expensive, process than the changing of a much used highway. So in this initial attack upon the traffic problem, we shall devote ourselves mainly to the discussion of automobile laws.

Here again the problem splits into two halves. The law deals with two classes of drivers. There is the man who is bent only on beating the game, who will violate all the laws with a light heart if he thinks he can get away with it or if the penalty seems less than the immediate profit. The law must deal with the problem of catching, restraining and penalizing this irresponsible driver, and in dealing with him, harshness should be the keynote. On the other hand, by far the larger proportion of motorists come in contact with the law only in what should be its beneficent aspects. To them, the law need be only a set of agreed-upon principles for insuring that all of us drive to the least interference with any of us. It specifies certain equipment which we must carry, not with the view of forcing us to carry it but in order that we may have a convenient and authoritative standard of reference. It prescribes the manner of our driving in general and in particular circumstances, not with the idea that we need to have a club held over us, but again so that each of us may have a standard by which to forecast the probable conduct of the other fellow. In defining and enforcing these and other necessary standards, the law can afford to err on the side of lenience. It can often correct without penalizing, it can even more often impose a light penalty as a mere jog to the offender's memory. It can and should reserve the display of its teeth for the habitual or the wanton violator. Inasmuch as those whose contact with the law comes entirely in its regulatory aspect vastly outnumber those who face the judge for the purpose of being punished, we again make a reservation for future consideration. The punitive side of the statutes will be dismissed from the present article right here, and we shall center our attention upon the regulatory aspects of the laws, rules and customs that govern the movement of traffic over the open road and the city street.

THAT there exists a traffic problem, everybody who drives an automobile is well aware. Just what elements go to make up this problem is perhaps not so clear, just where to look for a solution is even less evident. The great danger seems to be that, before the problem is defined and the solution found, the ordinary growth of the industry will have carried the situation completely out of hand. THE SCIENTIFIC AMERICAN *therefore proposes, during the coming year, to devote special attention to the attempt to reduce the traffic problem to its fundamentals and to strike upon the best means of relief, and the accompanying article, with its analysis of the possibilities, is the first gun in this campaign.*—THE EDITOR



The combination of the ferry from which these cars have just come, and the grade crossing, is a very troublesome one. Out of the picture at the left is a line of cars many blocks long, waiting their turn to reach the boats

It is axiomatic that the safe use of the highways by all of us depends upon proper knowledge by all of us of these laws, rules and customs. One who insists upon keeping to the left will get smashed up, but with him he will smash somebody who was dutifully keeping to the right. Your ignorance of traffic laws exposes to danger perhaps scores of people on foot and in other cars, who had counted upon your doing the usual thing. It hurts you just as much to be hit through the other fellow's ignorance of what to do as though he had pursued you across the sidewalk and into a shop window with the deliberate intent of enrolling you on the list of the week's automobiling casualties.

There was a time when the ways and means of your acquaintance with the law were purely your concern and your responsibility. Fundamental in our jurisprudence is the principle that ignorance of the law is no excuse for its violation. The principle is a wise one, and in general it must prevail. But when the circumstances are such that your ignorance of the law may damage others as badly as it can damage you, it is time for the law to ask whether some degree of responsibility for general knowledge of the statutes does not devolve upon the community as a whole. In the case of the traffic laws the answer to this is an emphatic "Yes."

We have seen parked simultaneously about the public square of Mansfield, Ohio, cars from twelve states. On the day of the Dempsey-Carpentier fight, we drove westward over the Lincoln Highway from New York to Gettysburg, and we passed cars from every state east of the Mississippi (outside of New England), headed toward Jersey City. From every southern state with one exception we saw at least six, from Illinois more than we could conveniently count. The American autoist does his driving on the roads of many states. Can he be sufficiently well acquainted with the traffic laws and usages of the states and communities through which he passes, to avoid the constant hazard of arrest for petty violations, the occasional peril of a major transgression, and the certainty that some of his actions will embarrass or puzzle other drivers? If the laws of all states were sufficiently similar, he obviously could. Equally clear is it that the laws of the various states *could be* sufficiently diverse to render it quite impossible for him to meet this demand.

In point of fact, the existing diversity is sufficient to have been the subject of comment and complaint, but seldom if ever has a bill of particulars been offered. Suppose we attempt this on a modest scale. Our basis is the printed pamphlets in which 38 of the states publish their motor codes. Alabama, Connecticut, Illinois, Michigan, Ohio, Oregon and South Carolina have failed to meet the request for such material; Arkansas, Oklahoma and West Virginia, asked for their motor codes, send only the laws that govern the financing, construction and maintenance of their highways. But the 38 which we are able to cite are ample to show the wide divergence that exists, and the impossibility of the tourist's having adequate knowledge of the motor laws of all the states which he traverses.

Twenty-six states make no demand upon the man at the wheel save that he have the price of a car—there doesn't appear to rest anywhere the obligation even to see that he learns to drive before he ventures on the public roads. Six states require a driver's license, issued originally after examination of some sort and renewed annually without further test. Two states issue licenses, but require merely the fee without any examination. One gives a permanent license after test. One licenses truck drivers after test and drivers of passenger cars without test. North Carolina leaves the licensing of drivers to local jurisdiction. New York requires examination and license from all residents of the metropolis, while up-state drivers go unsupervised. Practically all states license paid chauffeurs.

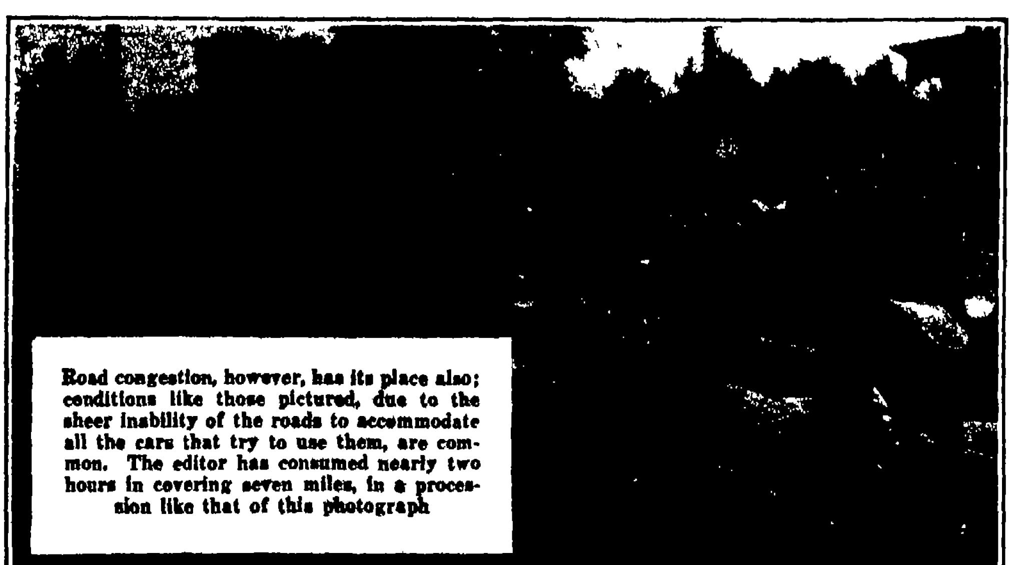
A glimpse of the traffic on a crowded street (Fifth Ave., New York) Before the installation of the block signal system of control, conditions here were far worse than in the picture Street congestion is probably the most costly aspect of the traffic problem today

The lack of uniformity here is not so flagrant as in other instances which we shall cite. Broadly we may say that the state either licenses drivers, or does not license them and that the question is of minor interest to the driver himself It is of major interest to the state authorities, however Failure to demand driving licenses makes it difficult to identify the driver personally, or to insure that he is authorized to drive the car in which he sits, it tends toward the presence on the roads of irresponsibles who could get a license with difficulty or not at all and it robs the law of the very valuable penalty of license revocation Further it embarrasses the states that do require licenses, placing upon their roads unlicensed drivers from other states who have complied with their home laws and hence are entitled to reciprocal privileges, but who are impossible of identification and difficult to control

Even where there exists no license requirement it is a simple matter to make it specifically unlawful for certain classes of persons to operate a motor vehicle All states make it a crime to operate a car while intoxicated and practically all license states punish this offense with revocation But when it comes to driving by children, the divergence is wide

Three states bar driving by those below 14 four make the limit 15, nine 16 one 17 and one 18 Two others have age limits which apply only in incorporated towns One restricts the age of paid chauffeurs only another exempts from its age limit children who can prove their competence Ten states make no provision whatever against driving by infants five others have age limits, but invalidate them by permitting children to drive when accompanied by an adult Kentucky alone puts this excellent idea to proper use with a limit of 16 for children unaccompanied, and 14 accompanied In fifteen states, it will be seen a child of six may go on the public roads in charge of an automobile without violating any specific law

Of course this is shocking on its merits, but it might appear that the lack of uniformity is of minor importance Where it actually hurts is in its effect upon the extension of reciprocal privileges Several years ago a New Jersey youth of 17 (just over the limit of his own state) was fined for driving in New York, where the limit is 18 The first motion on his behalf by the New Jersey Motor Vehicle Commission was rebuffed at Albany Only a last-minute acceptance of arbitration by the New York Commissioner averted drastic retaliation, which would have taken the direction of minute enforcement of every letter of the Jersey law against New York cars, and would have amounted to a suspension of reciprocity The difference between 17 and 18 years doesn t amount to much but what about, say, Kansas with a 14-year limit and Nebraska with none? When a Nebraska child of eight drives across the state line, is he subject to arrest for his very serious violation of the Kansas law, or does the fact that he can drive legally at home entitle him to reciprocity? There is good law and good logic on both sides of this question the only apparent way to settle it without any kickback is for all states to have the same age limit And why can't they do this? If it is safe for a 14-year-old to drive in Kansas, it is equally safe in New Jersey; if it is really improper for anybody short of 18 to drive in New York, it is equally improper elsewhere. Once granted a mechanism for reaching an agreement, there is no reason in the world why there should be more than one age limit for drivers in the entire United States. The difficulty, of course, lies in getting an initiative taken in such way as not to make any state legislature feel that it is being dictated to from abroad



Road congestion, however, has its place also; conditions like those pictured, due to the sheer inability of the roads to accommodate all the cars that try to use them, are common. The editor has consumed nearly two hours in covering seven miles, in a procession like that of this photograph

Suppose now we examine a point that interests the driver very directly What do *you* do when you overtake a street car that is standing to receive and discharge passengers? If you are a native of Idaho New Mexico, Pennsylvania Utah Vermont, Wisconsin or Wyoming, nothing is left to your imagination you stop and wait for the trolley to move unless there are safety zones But if you carry this custom from one of these states into some of the others you will get bawled out for obstructing traffic

In Florida you may slip past the standing trolley at five miles per hour in New Hampshire by exercising due care,' in Kentucky when you consider it safe to do so—not so idiotic as it sounds since it puts the consequences right up to you In Rhode Island the statute implies that you may sneak around the wrong way—a very unfortunate habit to take with you on tour since many states penalize it drastically In Indiana you may pass if you are able to do so at a distance of 20 feet otherwise you stop six feet behind the standing car, thereby giving its alighting passengers a chance to dash across behind it and get struck by approaching traffic Maine specifies eight feet beside or five feet behind the trolley Massachusetts is content with eight feet at the side—you may try to shove the obstruction off the track from behind if you regard this as profitable Minnesota requires ten feet at the side or the exercise of care, Nebraska eight feet and a 'slow passage California specifies ten miles per hour and six feet from the car Montana makes it six miles and eight feet New Jersey makes the margin eight feet but when there isn t space for this you may go around the wrong way by exercising "extreme caution This makes you absolutely responsible for if anything *could* happen you weren t exercising extreme caution in essaying the left hand passage The other 18 states of our list make no provision to cover this point of driving etiquette, which means that the municipalities will supply the deficiency leading to confusion within the state itself New York City, for instance has a law a little different from any we have quoted It prohibits the automobile from approaching nearer than eight feet *in any direction* and though it is plainly enough worded 90 per cent of drivers have to have it pointed out by a policeman or a magistrate that this includes the rear of the car and regulates the behavior of an auto that can t squeeze past and has to stop

Now there is just one reason for regulating the relationship between a moving automobile and a standing trolley It isn t done to be humorous or to annoy the motorist It is done to make it safe for people to board and leave the trolley It is very obviously not the case that this end needs to be achieved by different means in every state It is very obviously true that a convention which affords adequate protection to the passengers of the trolley in one locality will do so in other localities There is absolutely no reason in the world why all the states could not have the same law on this point—except for the difficulty of deciding just where the uniform law is to originate It is of course equally clear that this difficulty has been to date the dominating factor and that it alone is responsible for the divergence that exists To this point we shall return later

The speed limit is another very dreadful thing Discrepancy here takes two directions Every state almost, has a general speed limit designed to apply on the open road and lower limits designed to apply where traffic is heavy or the roadway dangerous Divergence is to be found in the specific figure named for the maximum and divergence is to be found not alone in the specific lower figures named for special localities but in the physical conditions which are laid down as defining these special limit zones.

Let us look first at the matter of general limits The states are about equally divided here on another matter of general principle Some of them name a figure which is not to be exceeded under any circumstances. Others set not an absolute speed limit but a figure which may not be exceeded without establishing *prima facie* or presumptive evidence of reckless driving If you drive faster than this and have a smash it is more or less distinctly up to you to prove that you were not careless or reckless In general *prima facie* speed limits are a bit lower than absolute ones Two states Maine and Maryland have both and curiously enough agree on the figures more than 25 miles per hour establishes *prima facie* evidence against the driver and more than 35 is categorically prohibited In all other states the driver has to read the book sometimes rather carefully to discover whether the published speed limit is an absolute one or merely a suggestion for him to keep in mind in the presence of other cars

As for the actual figures, five states specify 25 miles, sixteen name 30 and nine 35 As extremes we have 20 in Massachusetts and 40 in Kansas The Massachusetts limit of course is merely a presumptive one and is enforced with discretion the writer has split it wide open in the presence of traffic officers without a reprimand Three states ask for a reasonable and proper speed without stating any numerical limits and the pamphlet which Tennessee sends in response to a request for its traffic laws consists of a collection of isolated acts none of which says a word about speed except the one that demands a full stop at grade crossings Most drivers would probably agree that this increases the chance of stalling on the crossing and is therefore an unwise provision

There might be some argument that for instance a greater average speed is proper in Kansas than in

(*Continued on page 65*)

Psychic Adventures at Home

An Episode that Started as Formal Investigation, Lapsing into Adventure and Actual Comedy

By J Malcolm Bird

EVERY medium must decide for herself whether she cares to participate in our psychic investigation. She must consider our motives, the propriety and fairness of our undertaking, the feasibility of our conditions, and numerous other points. If on any grounds she decides not to work with us, our efforts to persuade a change of mind are kept within appropriate limits, both in degree and in kind. It is not our desire to harass any medium. But all data necessary for the choice between participation and non-participation are easily available, so that a performance like that of Mrs Tomson indicates on its face that we are being trifled with. On account of its interest we have decided to tell the accompanying story. Because it is one that revolves about the personality of the medium and that of her husband, we tell it as a tale of psychic adventure rather than of formal investigation. Because in this instance it IS an essential part of the story, we are NOT withholding the identity of the medium. —THE EDITOR

WHEN our psychic investigation was announced in our issue of January last, the first entry to come into our hands was that of Mrs Elizabeth Allen Tomson of Chicago. This entry was not forwarded by the medium herself; a lady whom we shall call Mrs J wrote on her behalf. The formal entry was followed by numerous letters, all expressing the medium's extreme desire to come before us at once and all detailing the financial difficulties of the trip. The Chicago *Tribune* had indicated such interest in our psychic program that we passed the word to them and they offered to finance and conduct the entire expedition. Miss Forbes of the *Tribune* staff had difficulty in getting to Mrs Tomson, *and more difficulty in getting* her decision. It was finally pleaded that her daughter's health was such as to render the journey impossible at that time.

Mrs J was allowed by the Tomsons to remain in ignorance of all this, her first knowledge of the *Tribune* offer and its refusal came from me, accompanied by my sharp interrogation whether she was really the authorized manager for Mrs Tomson or just a volunteer. The question was answered in the former sense, but still I had no direct word from the medium. In the meantime, a very objectionable two page spread appeared in certain Sunday newspapers in Chicago and other western cities. *There were several weird daubs* representing the artist's conception of ghosts and materializations, and the remaining space was filled by the statement reiterated in various ways, that Mrs Tomson was coming to New York to win our award. A few weeks later a short news item ran through the press of the prairie states, to the effect that she had come and had won it. That the Tomsons were in some way responsible for these stories seemed a natural assumption and one which I tentatively advanced in correspondence. One of these letters was passed on to the medium's husband, Dr C H Tomson, *and as a result, I was for the first time honored by a* communication direct from the Tomsons. This denied the charge which I had not made and it repeated the tale of the ardent desire to come to New York with the financial inability to do so. Several further letters from the Tomsons and from Mrs J followed in much the same tenor. In the meantime they had been able to finance trips to New Orleans and Kansas City, but not to New York.

Another phase of the matter has to do with the National Spiritualist Association. This body regards the medium as a fraud and has so stated in public print. *Great agitation was displayed by the medium's* representatives lest we credit these charges which they explained away at length, with free use of the word "persecution." In April while I was in Chicago, Mrs J spoke the same piece over the telephone and I had to interrupt her peremptorily to assure her that what other people thought about the medium would have no influence upon our Committee's deliberations. Our Judges were however necessarily aware personally of the fact that detailed charges of fraud had been brought against this medium at many times and places so that there existed fair presumptive ground for inferring *that many of her manifestations were fraudulent.* Under all these circumstances, it was difficult to believe that Mrs Tomson had any intention of appearing before us.

Late in October nevertheless, letters came informing me that Dr and Mrs Tomson and their daughter were en route to New York. On Sunday the 28th, they arrived. On Tuesday Dr Tomson called on me and refused point blank to tell me where he was stopping. Throughout their stay in New York, my only means of communicating with them was to call Mrs J at her hotel. Usually she was out and I could only leave a message for her to call me back. What I said to her she had to relay to the Tomsons with more or less difficulty, and she had to relay their answer. In the face of this Dr Tomson took every opportunity to impress upon me that Mrs J had no authority to arrange things for the medium and that her presence constituted an intrusion into their affairs which was bitterly resented by them.

On Friday, November 2, I was informed by Dr Tomson that the medium was to sit Sunday evening at the Raymond Hitchcock estate on Long Island. I was invited *to attend this affair, and to bring the entire Committee.* Upon my explaining that Houdini was in Texas and that the two Boston members of the Committee had no present connection with the case, the invitation was turned into a peremptory demand that I secure the presence of the entire Committee. Dr Prince and I actually attended, at much personal inconvenience. Dr Carrington had a business engagement of the utmost importance and was unable to go. His absence created a fresh storm of protest.

This Great Neck seance had been announced to us, in the invitation as an entirely informal one. The medium, we were told before entering a series of serious sittings with a given circle likes to meet the members in a friendly seance for purposes of social contact. It was on this understanding that we went. From the moment when we entered the house however, every effort was made to give our presence an official character. The social contact plea was a huge joke. The medium was held in seclusion in another part of the house. Our first glimpse of her was when she entered the cabinet running through the circle at top speed to reach it; at the end she left it with equal speed and greater suddenness. Two frantic flights through the semi darkened room were literally all we saw of her.

The cabinet was constructed after our arrival under Dr Prince's watchful eye. When all was *ready*, the room was far from dark, several of the windows remaining uncurtained. There was no moon and no electric light outdoors within the range of these windows but the night was clear and after one's eyes were adjusted to it the illumination from without was considerable. In addition a single blue bulb was lighted in the room, across from the cabinet. The actinic value of blue light is so much higher than that of red that a stenographic record of the sitting could probably have been made. Yet of course, the illumination was by no means sufficient to enable a close watch to be kept for suspicious *movements.*

Mrs Tomson's act consists in the "materialization" of 'spirit forms.' No definite claim is made regarding these. If one will one is permitted to assume that some of them are full materializations ' in which the medium would be expected to be on her chair in the cabinet while the ghost walked. But they are freely admitted to be "usually mere transformations," in which the physical shell of the medium is used as the foundation for the building up of the presentment of some departed person.

Many instances are recorded when these figures have been 'recognized' by sitters as those of their dead. The recognition applies particularly to the faces which are usually covered by veiling or some undefined material, and revealed only gradually and in part. If the actual degree of likeness could be determined scientifically and given a numerical index, several possibilities might be examined. It might be judged that the manifestation was not objective at all, that the medium had got, telepathically or otherwise, a mental picture of the departed which she had consciously or subconsciously imitated by normal physical means—a sort of animated or illustrated "spirit message." If the resemblance between the apparition and its *original* were high, it would be necessary to consider whether normal physical means could account for it, or whether on its face it were an objective phenomenon. The possibility would also be discussed that all the faces were but generalized types and that chance plus hysteria plus desire would account for the recognitions.

Regardless of this interesting and difficult question, however, there is one outstanding feature of the apparitions which is distinctly an objective phenomenon—whether genuinely psychic, or fraudulent. Precautions are taken that the medium has with her in the cabinet no white material, and the spooks invariably appear clad in flowing robes of white. These white garments must be explained on the one ground or the other.

At the Hitchcock seance, there were some thirty sitters—mostly theatrical people. In spite of *the advertised informal character of the* occasion, the presence of Dr Charles M Niesley of Manhasset had been secured for the purpose of subjecting the medium to anatomical examination. I am informed that Dr Niesley is one of Long Island's best regarded medical men. After he had finished his task, he turned the nude medium over to a committee of six ladies, who clothed her in a brilliant hued kimono belonging to Mrs Hitchcock. Clad only in this, they conducted her downstairs and she rushed so precipitately through the circle and into the cabinet that I was barely able to gather the impression that in form and face she resembled her daughter closely.

Mr John K. Braehvogel a member of the law firm of Munn Anderson & Munn was present by agreement with me and he had brought Mrs Braehvogel. Much against her will, the Tomsons insisted that she serve on the committee of ladies and, having got her on it they attempted to make her participation stand as an official and binding act by the SCIENTIFIC AMERICAN.

The charge has, naturally been made that the medium brings the white material into the cabinet concealed in one of her anatomical cavities; the medical examination is to insure against this. Dr Niesley interpreted *the problem as referring to the vagina alone* and directed his examination to that quarter only. He paid no attention to the rectum or the esophagus, and in fact had no instruments with him for so doing. Though he made clear the limitations of his work, Dr Tomson exhausted every device to get from him a blanket statement that the medium could not possibly have anything concealed anywhere upon or within her and similarly he struggled hard to make it appear that the SCIENTIFIC AMERICAN was a participant in Dr Niesley's findings and was bound by them. When confronted at a later date with the suggestion that the medium might have *carried material into the cabinet in a capsule of some* sort in the rectum, the esophagus or the stomach, Dr Tomson attempted to assert on his own authority as a medical man that this was an anatomical impossibility. The sword swallower and the ruminant are sufficient to enable any laymen to contradict this claim.

Dr Niesley examined the medium's hair. Mrs. Tomson, after he had left the room informed the ladies that he hadn't done so and got them to do it again. She may have made an honest mistake, but the fact that she went to the trouble of making such a false statement and getting this test repeated lends to the suggestion that on putting her hair up for the second time she concealed something in it more plausibility than it would otherwise have. None of the ladies was prepared to deny categorically that she could have done this.

If not actually taken into the cabinet within the medium, the white goods might have been passed to her, or planted in the cabinet. The cabinet finished, all sitters were invited to examine it, several did so, including myself. Then we were seated, the lights arranged, and we inferred that the medium was to appear. Instead of this, Dr Niesley first and then the ladies were designated and sent upstairs to do their work. During the ensuing interval of twenty minutes the seated group broke up, and had to be reassembled when the medium was really ready to appear. I could not testify that the cabinet was not tampered with in this interval, nor could I find anybody else who could. Dr

and Miss Tomson moved freely about during this highly artificial intermission. The procedure seemed sufficiently oblique to create active suspicion, which would be contradicted by no known facts.

When the medium made her dash for the cabinet, she actually brushed against her daughter, and the illumination was not such as to enable any sitter to acquit them of the possibility that something had been skillfully passed. In leaving the cabinet at the end of the sitting Mrs. Tomson without the slightest warning burst through the curtains like a firecracker, and the daughter leaped up and caught her mother in her arms, supporting her through the group of sitters. The conditions to make possible the act of passing a guilty bundle back to the young lady were here present to an alarming degree.

With the medium in the cabinet the sitting opened. Dr. Tomson and the daughter now made great show of not approaching the cabinet until after the first apparition had appeared. After a brief wait the curtains parted, and a white-clad figure stood in the opening for a moment. Then the seance routine commenced.

This routine involves the idea that each apparition is directed at an individual sitter. No announcement of his identity is made, the doctor or the daughter gets a sort of "hunch" as to who is wanted next, picks this sitter out of the crowd, takes him by both hands to guard against any deliberate or emotional rough stuff, and conducts him right into the very jaws of the cabinet. These roll apart, and the apparition is there. After a moment's inspection, the sitter is backed off a little by his conductor and the apparition follows, thereafter retreating into the cabinet.

At Great Neck there were two recognitions. Mr. Hitchcock recognized an uncle, or a grandfather, or perhaps both, with heavily bearded face. One of the ladies, who stated that she had never met the medium or been interested in spiritism, was reduced to a condition of emotional crisis by her very positive recognition of her mother's face and voice (in the four words "My own darling child!") This lady was embraced and kissed by her apparition, and several other sitters were touched by fingers or drapery.

In two trips to the cabinet I was not touched. The first time, the figure was heavily veiled and Miss Tomson tried to convince me that there was ectoplasm in active movement upon the face. Finally the veil dropped suddenly, and though the head then rolled violently backward and the curtains closed quickly I was positive that the face was the medium's. Even so, of course no damage would be done her claims. On my second advance, the face that was presented had a curious unfinished appearance, as though the features were but half formed. The figure on this occasion avoided close inspection so that I could not check this impression.

So far as I could see none of the figures was notably different in height or girth from that of the medium. At one point there were several words of good evening addressed specifically to me from the cabinet in a heavy bass voice. Though this impressed me as obviously artificial Dr. Tomson insisted that it was the voice of his father-in-law. The opening was not pursued.

Apparently the only avenue of attack for one seeking to demonstrate the character of these manifestations lies in consideration of the white drapery. The consensus was that this was a textile fabric—tulle was the word most often used in simile. In the advance notices which were given us of the performance, emphasis was placed heavily upon the unwrinkled appearance of the robes, and the extent to which the edges stood out crisp and unfolded. All this was exaggerated. I thought the substance could easily have been a fabric sufficiently light and soft to stand up, under close packing, well enough to account for its appearance.

Mrs. Brachvogel was quite certain, from the way the robes hung, that we were dealing with a made garment, and not with mere yardage of loose cloth. Incidentally, the yardage necessary to produce what we saw was again grossly overestimated in the extravagant advance statements. Likewise we were given to anticipate a fluidity and freedom of the white material (suggesting of course that it was ectoplasm) which the performance did not achieve.

Psychic supporters would accept no adverse verdict based upon capture and analysis of a bit of this material. Even if it were identifiable as the product of a given mill, the believer would accept it as an apport, brought to the cabinet from a distance, by psychic power, for the medium's use. For a scientific disposal of the case, the question how it got into the cabinet would have to be discussed from every angle. So far as the Great Neck sitting goes conditions were too loose to permit the exclusion of obvious possibilities. It is of interest to record however, that no sitter outside the medium's party was prepared to discuss the manifestations from any other angle than to ask "Where did she carry that stuff?"

On Friday, November 9th the Tomsons gave a public seance at a spiritist church in Brooklyn. They had already attempted such a performance on Tuesday the 6th, but the doctor demanded that the collection precede the seance, while the church people insisted that the seance precede the collection. The net result was no seance—and no collection! The people who arranged the Friday sitting were sincere spiritists who nevertheless, believed that this particular medium was a fraud and they planned to expose her at all costs. The climax came when one young man with an Irish surname, confronted with a ghost and finding his hands securely held, reached forward and bit the apparition! The sitting at once broke up in a free fight, although Mrs. Tomson postponed the faint with which she usually meets rough tactics until she was safely upstairs. The biter stated that he got a mouthful of cheesecloth.

Lots of well meaning folk are always trying to tell *us* how to catch our mediums red handed. The general idea seems to be that one needs only to flash a bright light, or start a rough house of some sort. Without any criticism of those who do it this way, we do it differently. We do not start with the assumption that the medium is a crook, but rather with the assumption that if he is one the instrumental tests which would give us the necessary information about genuine phenomena will do as well with fraudulent ones. The precipitate people who see, in the imagined success of biting, grabbing, etc., a condemnation of our slower methods or even of our willingness to sit with a medium who if a fraud could be caught by this rough stuff miss the point entirely. At the same time we are the last people in the world to deny that there is a certain delicious humor in the idea of biting a ghost and finding that its precious ectoplasm is merely a mouthful of cheesecloth.

Our first test seance with Mrs. Tomson, in which we hoped to advance toward knowledge of the source as well as the nature of the white robes, was scheduled for Wednesday evening, November 7th. As usual we planned to sit in the law library of Munn, Anderson & Munn. This room is carpeted, completely shelved for and lined with books wherever door and windows permit, rather handsomely furnished—altogether comfortable and cozy. Numerous authorities and several mediums have seen it and none has suggested that it was not a good place for psychic work. Mrs. T herself was enthusiastic regarding its advantages.

Shortly after noon on Wednesday, Dr. Tomson called upon me accompanied as always by his chauffeur. Whether he regards this man as a bodyguard or a witness I do not know but I have yet to see him without him. He asked to see the room where we were to sit. He wasn't fairly over the door sill and had not looked at the room at all before he stated in so many words that it would never, never do.

The only reason which he could present immediately in response to my query was that there were no facilities for disrobing the medium. I showed him there was a comfortable dressing room with running water two steps across the hall. So he shifted his ground and made the less easily controverted statement that the library lacked the psychic atmosphere.

Pressed to be more specific, he asserted that the room gave the impression of a public rather than a private place. I feel strongly that the reverse is the truth but I merely reminded him that the medium has sat often and successfully in theaters and pulpits, and asked him in what way these places had an atmosphere of privacy which our library lacked. He explained that the difference lay in the circumstance that in the theater or the church *the audience was remote*. I was quite ready to grant that for this medium, this was an important consideration but I was surprised to have her husband urge it. I pointed out not the suspicious character of the claim but merely the obvious inconsistency—that such remoteness surely increased rather than decreased the resemblance to a public place.

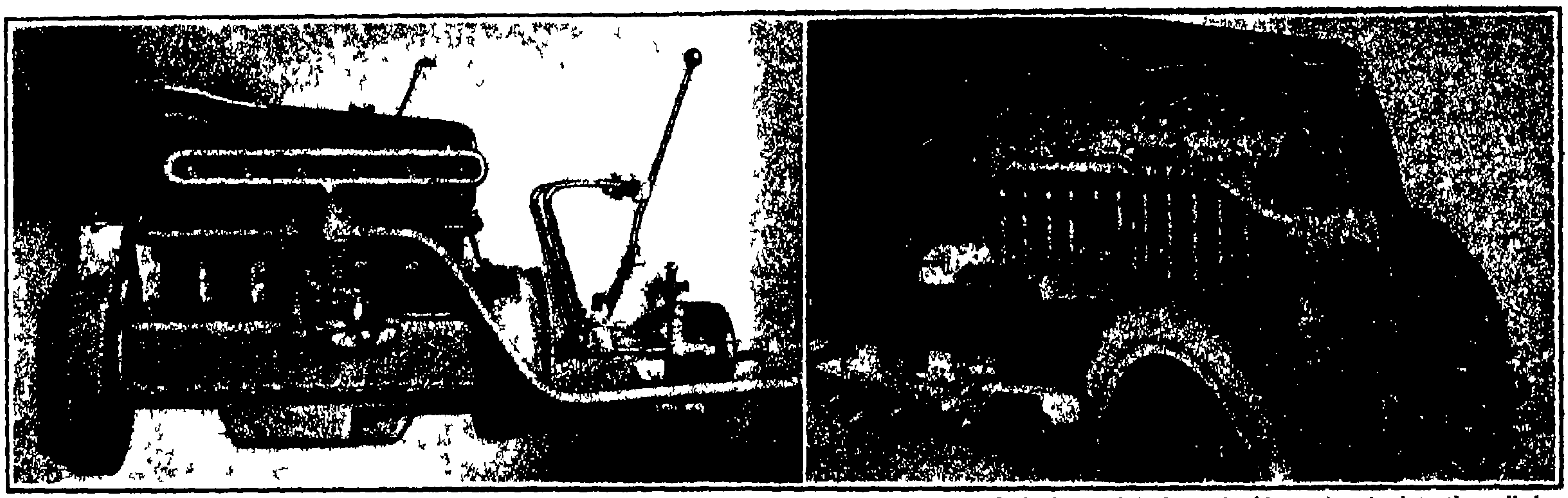
The doctor stuck to his guns and ultimately asked whether we could not go out to sit in a room in a private residence somewhere. I replied that on general principles we perhaps could but that on eight hours notice we couldn't. There would be not alone the physical problems of the last minute shift but also the finding a place—not everybody wants a seance held in his living room. The doctor very kindly offered to take this load off my shoulders. Mme. So-and-So, a friend of his he was sure would offer a room in her apartment.

No I didn't laugh in his face. I pointed out gently but firmly that if our investigators were to place themselves in a position where they might have to render a favorable verdict this must be of such character that our readers could accept it and that they certainly couldn't accept it if we told them that we had sat in premises over which we had no control. This brought up the whole question of the propriety of our conditions and even of the propriety of our imposing any conditions at all. We had announced that if the conditions which we proposed to any medium were in her judgment inhibitive of the phenomena we should be willing to discuss the possibility of attaining in some other way the end at which the offending conditions were aimed. Dr. Tomson tried to interpret this as obligating us to concede any demand which he might make for the abatement of conditions which he didn't like. The further he went the more absurd he got until finally he was talking about supplementing our judges with three of his own choice! I finally reminded him that we weren't submitting ourselves to his test, he was submitting to ours, that if he didn't like our rules he needn't play the game at all but that if he wanted to play with us we were the rule makers. He thought this horribly unfair and one-sided. He finally delivered his ultimatum, they would sit on premises selected by them or not at all. So I called up my committeemen and my sitters and told them it was all off.

Thursday noon he ran in again—still with the chauffeur. He apparently thought I had been bluffing and would recede. He asked whether we were prepared to sit outside our offices. No proposition to sit that day being involved I indicated our willingness to hold the seances in the apartment of Mr. Orson Munn. Even this concession wasn't enough, he made the specific point in so many words that the medium would sit only in a place where we could have no preliminary control of the premises. I accused him of concealing his real objections to our law library and told him that in my judgment he was afraid of apparatus which he pictured as concealed in the walls and floor behind the books, etc. He wouldn't deny this charge.

As before he carried the discussion afield. He made it very clear that they proposed to give us one sitting and to demand a verdict on that slender basis. He referred several times to the Great Neck sitting as an opportunity which we had already had to examine the phenomena and expressed anew his indignation that our entire committee hadn't been present. Yes he had read our conditions but of course in the case of a medium so well and favorably known as Mrs. Tomson we must be prepared to waive these! As a matter of fact Mrs. Tomson was pretty tired of these alleged scientific investigations and these physical examinations and she was not at all sure that she wanted any more of them. I asked him why they had entered our investigation if they felt that way about it, and he said that they never had entered it. I asked him what he was doing in my office in that event and he didn't seem to know exactly. He finally realized that we were going to run our own investigation in our own way and that we didn't greatly care whether he and his medium worked with us or not. So then he went away with a parting shot to the effect that we were being financed by the Catholic Church and that our whole investigation was a fraud designed to discredit innocent mediums. My parting shot was that I didn't believe he had at any time had any intent of sitting with us. Aside from these minor items, we agreed perfectly upon all points,

THE SCIENTIFIC AMERICAN *has undertaken an investigation of psychic phenomena of objective character, aimed primarily at deciding whether such phenomena occur, and secondarily at learning their cause if they do occur. The manifold subjective manifestations of psychism are for the present excluded from our investigation, because we are prepared to admit that they occur. We have invited all physical mediums to work with our Committee of Judges who as we have emphasized, are examining phenomena and not mediums. Less as an inducement to the medium, than to assure the public of the reliability of any favorable verdict which we may be called upon to render, we have offered $2,500 to the first medium who is successful in the production of psychic manifestations of a physical character before our Committee and under their test conditions. An outline of the proposed conditions the membership of the Committee, etc., etc., will be found in our issue of January 1923.*—THE EDITOR



External and internal views of the latest model of the leading air cooled car, showing the manner in which the conduit from the blower is joined to the cylinder assembly, the path of the cooling air, etc.

The Future of the Air-Cooled Car

Engineering and Operating Facts that Call for Its Most Serious Consideration

By Victor W Page, M S A E

THE thermal efficiency of any form of heat engine is determined by the ratio of the power obtained to a definite fuel consumption A certain amount of energy will be liberated in the form of heat when a pound of any fuel is burned If the greater proportion of the heat units derived by burning the explosive mixture could be utilized in doing useful work the efficiency of the gasoline engine would be greater than that of any other form of energizing power There is a great loss of heat from various causes among which can be cited the reduction of pressure of the expanded gas through cooling the motor and the loss of heat through the exhaust valves when the burnt gases are expelled from the cylinder These losses vary in different designs some of them can hardly be reduced others can be changed by altering details of design

The loss through the water jacket of the average automobile power plant exceeds 33⅓ per cent of the total fuel efficiency This means that in most cases more than one-third of the heat units that should be available for power are absorbed and dissipated by the cooling water Another third is lost through the exhaust valves leaving but 33⅓ per cent of the heat units available to overcome motor friction and do useful work A great loss of heat through the cooling systems cannot be avoided as some method must be provided to keep the temperature of the engine within proper bounds However cooling any engine is not a problem in refrigeration and the term must be used advisedly It is apparent that the rapid combustion and continued series of explosions by which the engine develops its power would soon heat the metal portions of the combustion chamber and valves to a red heat if some means were not taken to conduct much of this heat away The high temperature of the parts of an uncooled engine would burn the lubricating oil even that of the best quality and whether of mineral or organic origin and the piston and rings would heat and expand to such a degree especially when deprived of oil, that they would stick and work hard in the cylinder This would score the walls and the excessive friction which then ensued would tend to bind the parts so tightly that the piston would ultimately seize bearings would be burned out, the valves would warp and the engine would soon become inoperative Some owners of water cooled cars who neglected to fill the radiator will recall some of the troubles mentioned to their sorrow

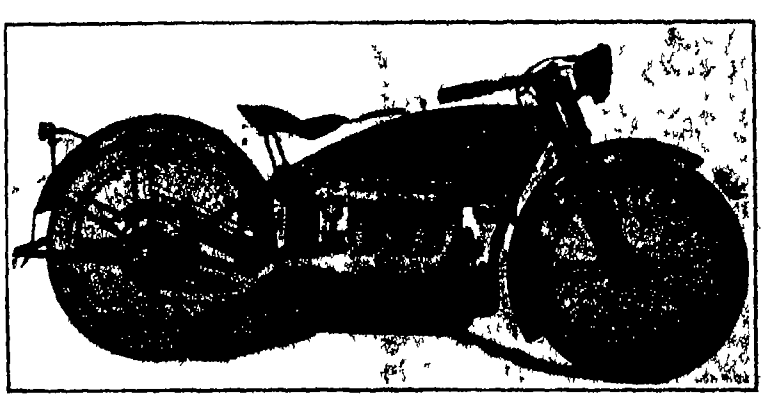
The best temperature to secure efficient operation is a question on which considerable difference of opinion exists among engineers That the efficiency of an engine is dependent upon the ratio of heat converted into useful work compared to that generated by the explosion or rapid burning of the gas is an accepted fact It is very important that the engine should not get too hot and at the other hand it is equally vital that the cylinder be not robbed of too much heat The object of cylinder cooling is to keep the temperature of the cylinder below the danger point so the oil will not become unduly heated and thinned but at the same time to have it as high as possible to secure maximum power from the gas burned Air-cooled engines can be operated successfully at temperatures higher than the boiling point of water, which limits water-cooling

Typical power plant of a light, air-cooled car

There are two general systems of engine cooling in common use that in which water is heated by the absorption of heat from the engine and then cooled by air passing through a radiator and the other method in which the air is directed on to the cylinder and head, which must be increased in external area, and absorbs the heat directly instead of through the medium of water When the liquid is employed in cooling it is circulated through jackets which surround the cylinder and head castings and the water may be kept in motion by two methods The one generally favored is to use a positive circulating pump of some form which is driven by the engine to keep the water in motion The other system is to utilize a natural principle that heated water is lighter than cold liquid and that it will tend to rise to the top of the cylinder when it becomes heated to the proper temperature cooled water from the radiator taking its place at the bottom of the water jacket A new development being experimented with is steam cooling, in which water vapor is used instead of the liquid

Air-cooling may be by radiation or convection In the former case which applies only when small stationary engines are used and then but seldom the effective outer surface of the cylinder is increased by the addition of flanges or spines cast thereon, and the air is depended on to rise from the cylinder as heated and be replaced by cooler air this producing a natural but sluggish circulation When a positive air draught is directed against the cylinders by means of a mechanically-operated fan, cooling is both by radiation and convection, which means air in motion In latest types of engine the air draught may be directed against the cylinder walls by some form of jacket which confines all of the air current to the heated portions of the cylinder, which it passes at fairly high speed

The earliest known method of cooling the cylinder of gas engines was by means of a current of air passed through a jacket which confined it close to the plain or unfinned cylinder walls. The gasoline engine of that time was not as efficient, being much cruder in all details, when compared to the later forms, and other conditions which materialized made it desirable to cool the engine by water Even though gasoline design and materials used in their construction became more and more perfected, there has always existed a prejudice against air-cooling, though many forms of engines have been used both in stationary and automobile, as well as in motorcycle and aircraft applications where the air-cooling method has proven to be very successful and practical This prejudice on the part of the layman is accounted for largely in the writer's opinion, by the preponderance of automobiles sold in which water-cooling is used exclusively



Four cylindered motorcycle cooled by current of air created by the passage of the machine through the atmosphere

The simplest system of air-cooling is that in which the cylinders are provided with a series of flanges which increase the effective radiating surface against which an air current from a fan is directed to absorb the heat. This increase in the available radiating surface of an air-cooled cylinder is necessary because air does not absorb heat as readily as water, and, therefore, more surface must be provided in order that the excess heat be absorbed sufficiently fast to prevent overheating. Air-cooling systems are based on

a law formulated first by Newton, the rate for cooling for a body in a uniform current of air is directly proportional to the speed of the air current and the amount of radiating surface exposed to the cooling effect.

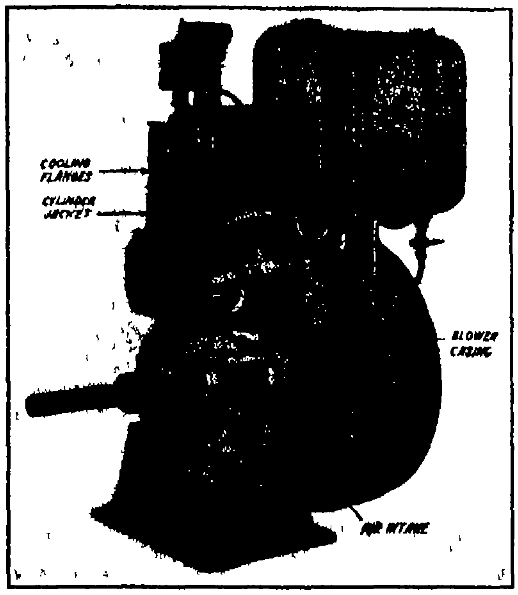
There are certain considerations which must be taken into account in designing an efficient and satisfactory air-cooled engine, which are sometimes overlooked in those forms cooled by water. Large valves must be provided to insure rapid expulsion of the flaming exhaust gas and also to admit promptly the fresh cool mixture from the carburetor. The valves of air-cooled engines are usually placed in the cylinder head in order to eliminate any pockets or sharp angled passages which would impede the flow of gas or retain some of the products of combustion and their heat and new steels are used, which will not warp. When high power is desired, multiple-cylinder engines should be used as there is a certain limit to the size of a successful air cooled cylinder when used in automobiles, it being unwise to use cylinders larger than five inches bore. Much better results are secured from those having small cubical contents because the heat from small quantities of gas will be more quickly carried off than from greater amounts. All successful engines of the automobile type which have been air-cooled have been of the multiple-cylinder type and the use of single cylinders is confined to power plants of less than five horsepower such as used in motorcycle construction or small stationary engines of not more than three to five horsepower.

An air-cooled engine of the simple or fan-cooled type must be placed in a chassis in such a way that there will be a positive circulation of air around it all the time that it is in operation. This air current may be produced by a fan or blower at the front end of the motor, by natural draught when a car is in motion as in the Rover, a small English car, or by a suction or blower fan in the fly wheel, the best exponent of which was the Franklin car prior to 1922. Greater care is required in lubrication of the air-cooled automobile engine cylinders and only the best quality of mineral oil should be used to insure satisfactory oiling. The oil must be viscous and heavy bodied because it is thinned down by the temperature of the parts. Castor oil is used in airplane engines of the air-cooled type, especially the revolving cylinder fixed-crank types such as the LeRhone or Gnome.

The combustion chambers must be proportioned so that distribution of metal as regards its thickness is as uniform as possible in order to prevent uneven expansion during increase in temperature and uneven contraction when the cylinder is cooled. It is essential that the inside walls of the combustion chamber be as smooth as possible because any sharp angle or projection may absorb sufficient heat to remain incandescent and cause trouble by igniting the mixture before the proper time. The best grades of cast iron should be used in the cylinder and piston and the machine work must be done very accurately so the piston will operate with minimum friction in the cylinder. Airplane engines sometimes have aluminum cylinders with steel liners but this is expensive construction.

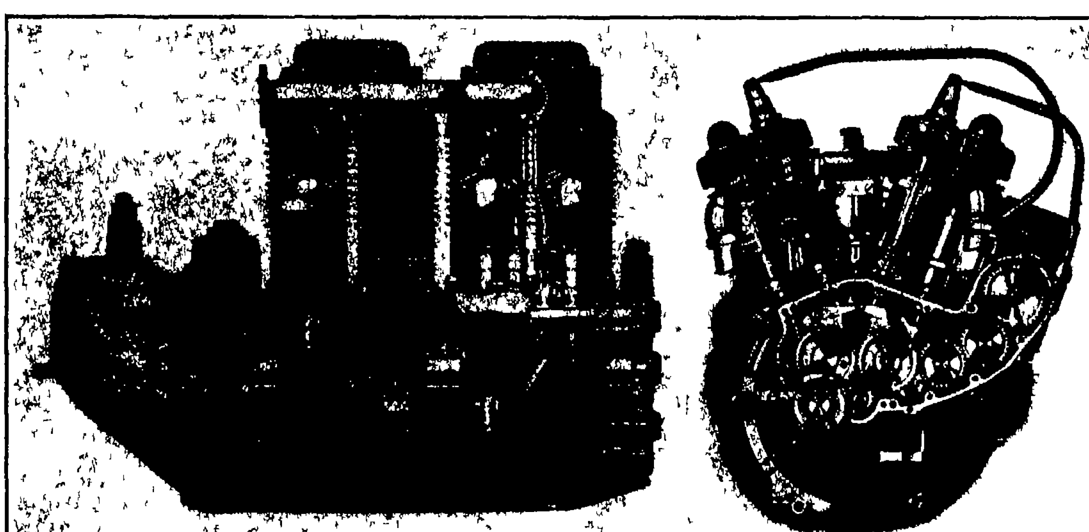
One of the important considerations in connection with air-cooling of engines having more than three-inch bore is that the air blast must be confined as close to the cylinders as possible and that a more energetic flow of air is needed than with water-cooling systems. The ordinary form of sheet metal blade fan is considered entirely adequate for water-cooled engines, but most engineers who favor air-cooling at the present time use fans of the airplane-propeller or blower type, which will furnish larger quantities of air than the simple fan would and which also direct it to the cylinders in a positive manner by enclosing them in air jackets which are attached to a manifold member running over them to which the discharge opening of the blower is coupled. The shape of the conduit is determined by careful computation and experiment to secure a smooth air flow.

Two engines by the same maker one of relatively modern development which utilize positive air cooling methods, can now be described. The system of cooling is practically the same in both instances, except in the methods employed of creating the air blast. In the early Franklin system the cylinders are provided with vertical ribs or flanges and are encased by jackets which form part of a sheet metal casing that covers the entire portion of the power plant. The fly wheel is provided with a series of curved blower blades around its periphery and as it turns, it creates a partial vacuum in the compartment formed by the motor base casing and the air tight



A relatively new stationary air-cooled engine using blower to create a blast

underpan. The strong suction effect draws air in from the front end of the bonnet and down through the cylinder jackets. The air currents pass over and between the flanges at fairly high velocity and as there is a large amount of exposed surface the excess heat is promptly disposed of and absorbed by air passing around the cylinders, which is ejected from the motor base compartment by the action of the blower fly wheel. As the fan is part of the balance member which is attached to and driven directly from the engine crankshaft there can be no failure of the driving means and a positive air draught must be induced around the cylinders as soon as the motor is started. The velocity of the air currents increase directly as the motor speed augments, and positive cooling is obtained under all conditions. This system was used very successfully for a period of many years and is unchanged in essentials even at the present day.



Two simple motorcycle engines in which air-cooling is accomplished by currents produced by the passage of the cycle through the air, without the use of any blower

In the cooling system which was used in the Frayer Miller engines nearly twenty years ago also in the Renault air-cooled aviation motor and which in improved form is shown in detail in the illustration of the latest Franklin engine the method of cooling is different in detail but practically the same in principle as that previously described. An air blower is mounted at the front end of the motor and the strong current of air it produces is conveyed to an air conduit at the top of the cylinders to which are attached the jackets surrounding the cylinder walls. The cylinder heads are only plain castings without ribs but the cylinder wall area is increased by using a large number of steel flanges which are cast integrally with the cylinder. The air blower forces a blast of air into the air conduit above the cylinders at considerable pressure, and the only way it can escape is by passing around the heated portion of the cylinder head and cylinder before it is discharged through the bottom of the air jacket. As the blower speed increases with engine speed the value of the air current becomes greater when an augmented cooling effect is desired. The blower handles cold air whereas the suction fly wheel had to handle heated air. A given amount or weight of air occupies less volume when cold than when heated so the blower to move cool air can be smaller and consume less power than the larger-capacity blower needed when it is incorporated in the fly wheel and must draw out warm air. It is mainly for this reason that the new Franklin system is stated to be an improvement over that used so successfully over a long period of years.

The flanges are not always of steel or cast iron, one prominent motor car manufacturer announced last year a motor in which copper flanges were intimately bonded with the steel cylinder wall by new brazing system. As copper carriers heat away about three times as fast as steel or cast iron its use is an improvement. Aluminum flanges and cylinder with a steel or cast iron liner for the piston to bear against have also been tried but extremely accurate and expensive manufacture and careful proportioning of parts are called for so that the cylinder and liner will expand together. The cast iron cylinder with integrally cast flanges is practical and the cheapest construction.

Among the advantages stated for air cooling by its adherents the greatest is the elimination of cooling water which is a factor of great moment. In the temperate zone where the majority of automobiles are used the weather conditions often change in a very few weeks from the warm summer to the extreme cold of winter and sometimes one has these variations take place in a few hours. When water-cooled systems are employed it is necessary to add some chemical substance to the water to prevent it from freezing. The substances commonly employed are glycerine wood alcohol or a saturated solution of calcium chloride. Alcohol has the disadvantage that it vaporizes readily and must be often renewed. Glycerine is said to affect the rubber hose while the calcium chloride solution crystallizes and deposits salt in the radiator and water pipes. Then there are the troubles incidental to leaky pipes pump and radiator failure of pump clogging or rupture of rubber hose and other difficulties.

Obviously the elimination of water and the use of a well designed air cooling scheme will provide a system that should be fully as effective during the extreme cold weather as it is during the more favorable summer season. It would seem that air cooling methods could be applied to advantage in the future more than in the past, to commercial vehicle power plants which must be capable of efficient service under widely varying conditions. One of the disadvantages of the air cooling method as stated by those who do not favor this system is that engines cooled by air cannot be operated for extended periods under over loads or at very high speed without heating up to such a point that premature ignition may result. Experience has shown that this objection cannot be raised against the blower-cooled engines. The water-cooling systems so it is claimed maintain the temperature of the engine more nearly constant than is possible with an air cooled motor and an engine cooled by water can be operated under conditions of inferior lubrication inaccurate valve

(Continued on page 71)

Floating the Car on Oil

Little Known Facts About Automobile Lubrication and What It Means in Terms of Wear and Tear

Photographs Copyrighted by Lubrication and The Texas Company

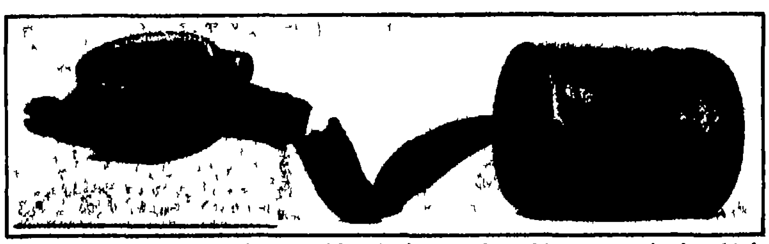
Excessive "choking" of fuel mixture was responsible for the scoring of this piston Spots around two small oil drainage holes indicate that dilution or "cutting" of oil was complete

IN lubricating by means of oil, we simply supply a very large number of minute ball bearings between two surfaces These balls are little particles of oil and the more viscous the oil the harder it is to break them up *The art of lubrication is the art of* getting the right amount of oil in the right place at the right time In the modern automobile this is pretty well provided for by numerous patented devices and so it has come down to the human factor—that is when trouble results in the parts that require lubrication it is generally owing to the owner's failure to supply lubricants, or to the use of the wrong lubricant, or to some other factor, such as that of crank-case dilution which damages the correct lubricant which may have been supplied actually rendering it a non lubricant

Inventive genius keeps working out new and better ways to preclude damage from incorrect or omitted lubrication but the human equation still remains, and in dealing with the latter the inventor is truly up against it You cannot make people do their part always right The only way is to keep talking about it *in their hearing or vision and hope for an approxima*tion to perfection It is by no means the novice who over lubricates the most obvious part of the car the motor and neglects the dozens of little, hard to-get at places on the chassis The novice is generally conscientious about these following out the advice of the manufacturers until he discovers that some older hand makes an apparently good go of it without all this bother Then he gets careless Unfortunately the troubles that result are apt to be delayed for quite a long time But when they come there is usually a whole crop of them at about the same time The buyer of a second hand car often best realizes this Everything seems to disintegrate all at once the result of the previous owner's omissions much earlier in the game

In the case of a second hand purchaser who has his eyes open the resale value of a car which has had its minor lubrication neglected will be very greatly reduced for he appreciates the general overhauling it will soon require Such a car squeaks Squeaking is a cry for lubrication—parts are wearing out fast Go into the junk box of any repair garage and paw over the discarded parts you will find there and you will discover a sermon whose text is "lubrication" Here is a spring shackle bushing that is nearly worn through Oil or grease would have saved it and the cost of a *premature replacement, not to speak of the thousands* of squeaks that accompanied the wearing out. Here is a shackle bolt with empty grease cups turned down tight The driver of that car took pains as long as it was dead easy—then let it go The shackle bolts are worn one-third through Next comes a universal joint There is not much movement in universal joints but there are millions of these small motions. Sooner or later the old lubricant is gone and more is needed In this case someone forgot it and the thing ran on until the metal was all galled up and in some places had seized It has been calculated that neglected chassis lubrication alone costs the people of the United States about seventy five millions of dollars in repair bills every year

In any discussion of lubrication of the automobile that of the motor itself naturally occupies the greatest attention At no other point is there so much relative motion of sliding parts and this is complicated by the two facts that first, the motor develops a high degree of *heat, and second that the fuel used in the motor is,* before it is burned introduced directly against the cylinder walls, and here there is more linear motion than at any other point on the car The first problem that of the high degree of heat, is being, in fact has been, improved away Oils having high flash points are no longer difficult to get But the second problem, that of the fuel is growing worse Gasoline is growing less and less volatile Less and less is it successfully vaporized by the carburetor, and more and more especially as engine speeds tend to increase does it reach the firing chamber merely in atomized form Since about 1910 the consumption of gasoline has increased many fold and while the production of crude oil, from which it is derived, has increased greatly it has not increased enough to make it possible to derive even with the improved "cracking" methods now used enough gasoline of the old standard to go around The



When the lubricating oil became diluted with gasoline this piston seized at high speed The lower or crank shaft bearing was not injured

result is a grade of gasoline which "overlaps" the early kerosene in the sense that part of the constituent of the crude oil that would then have gone into the kerosene now has to go into the gasoline In this connection it should be stated that this does not mean as one often hears that "they are putting kerosene into the 'gas these days' A direct mixture of kerosene and gasoline would not be a return to the same crude from which these two were obtained Humpty-dumpty cannot be put back again that simply

This matter of the lower volatility of present-day gasoline has a very direct bearing on motor lubrication It gets into the cylinder oil in the crankcase and dilutes it. Engine troubles follow Once in a while one hears the owner of a car state that his motor consumes almost no oil—in fact it seems to make its own oil The truth is that it accumulates more liquid in the crankcase but that liquid may run even up to a 90 per cent content of gasoline But gasoline is not a lubricant, even if such a mixture, owing to the carbon and metal particles it contains, has the appearance of partly used oil

It is because the gasoline is growing less and less volatile from year to year that manufacturers who formerly advised draining the crankcase every thousand miles, are now crowding this maximum down to 500 miles, and in some cases to 300 The low volatilizing quality of the newer fuel means that it reaches the cylinder more and more in the form of spray instead of vapor, and since gases moving through tubes at velocities of over a hundred feet per second take on a whirling motion they are delivered to the combustion chamber with the 'atoms' of atomized fuel whirled centrifugally towards the outside of the cylinder walls.

Reaching this point they do just the very worst thing they could do that is, they wash off the fine film of lubricant that has been left on the walls by the down or suction stroke of the piston The next up stroke the compression stroke, greatly helps to move them downward into the crankcase, and more aid is *given by the ensuing explosion The only 'cures" at* present known for this condition are only partial cures One is to use very tight rings, a thing that may help considerably The other is to keep throwing away oil and putting in new This costs money but so does poor lubrication Just now there is a movement toward methods of reclaiming used oil, and if it proves successful we may find it possible to get a rebate on our used crankcase oil, turning it in in small amounts to be reclaimed We shall then be less unwilling to renew the oil in the crankcase The new process, it is claimed returns the old oil at least to the standard of quality of new oil In fact, the proponents of one process which is soon to be commercialized state that oil reclaimed by this process is a trifle superior to brand new oil Like a new motor, oil must be 'broken in

In winter lubrication problems become worse The car needs more careful watching for troubles due to faulty lubrication can arise more quickly in cold weather Probably the chief of these trouble sources *comes from* using a choked or rich mixture Since the choke is often used until the motor as well as the water in the circulation system has reached a temperature that will permit vaporization of all of the fuel in winter weather this means that a steady trickle of gasoline is finding its way down into the crankcase. This will result in overheating and excessive carbonization As soon as possible, therefore the choke should be pushed in and the engine otherwise be kept spinning by traversing the throttle until it has warmed itself up, not forgetting that "roaring" the engine at this time is about the worst thing that could be done to it since the lubricating oil is not yet warm enough to flow freely just when

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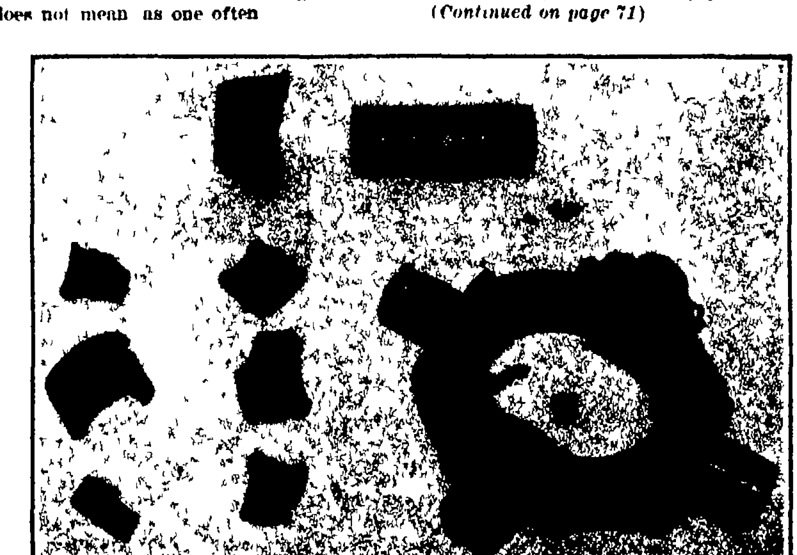


Universal joint failure brought about through lack of lubrication, despite the fact that pins and bearings are case hardened steel

Balloon Tires and What They Mean

Remarkable Results Obtained by Increasing the Size of Tires and Reducing the Air Pressure

WERE it not for his knowledge of what it would do to them, every motorist would probably prefer to run with poorly inflated tires. Many of them do. It is comfortable and it lets up on the car as well, for there is much less vibration. Unfortunately, running on pressures in any measure below those for which the tire is designed injures the tire walls. Not inflating the tire fully, under the belief that it favors the tire by putting it under less stress, is about the worst thing one can do to it. Under these circumstances it gets a sharp flexion at its walls twice with every revolution, and since its thick walls are not designed for this sort of motion ply separation becomes serious and there is fabric failure on the inside plies. Regular tires cannot withstand much of this sort of punishment.

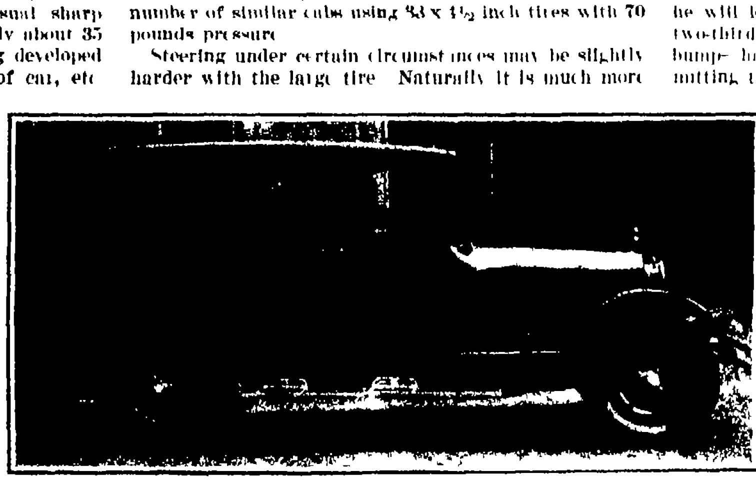
The new "balloon" tire which has just appeared on the market gets around this difficulty and permits the use of pressures something less than half of those in common use today because it is made up specially with thin side walls which are not injured by the one thousand flexions per mile of travel which the side walls receive.

Now if you are going to halve the pressure of the air then your car whose weight remains the same will settle down until the area of contact between the tire and the road is automatically about doubled. On a tire of the sizes now commonly in use, this would cause so much distortion of the shape of the wheel, (regarding the wheel as the wheel plus the tire) that even if you were to give the tire thin walls you would get a condition of extreme distortion which would be highly inefficient from every point of view. The obvious remedy for this would be to do just what the designers of the new tire have done. They have greatly enlarged it. The balloon tires look like great doughnuts and it has been facetiously suggested that Rube Goldberg the famous cartoonist was the inventor of this style of tire because he always portrays an automobile with grossly exaggerated tires!

The work of perfecting the balloon tire was started in 1916, but the World War prevented much being done with the idea until 1920. Then the problem was tackled in earnest. Success came in 1922 and the new tires are now on the market.

The balloon tire tones down road irregularities simply by enveloping them and going on as if they were not there. This statement must of course be limited, but such road obstructions as stones, stray bricks, the low sharp-edged planks at railroad crossings and even broken bottles simply disappear into the tire while it is passing over them. By far the largest proportion of the surface of the tire in contact with the road goes on carrying the car without giving it the usual sharp upward throw. The balloon tire carries only about 35 pounds of pressure and in some types being developed it carries still less, varying with weight of car, etc.

The sensation produced by riding on a car equipped with the new comfort tires is that of floating along almost wholly in a horizontal plane. It is "riding on mush." There is no comparison in the relative comfort. In fact it is more a matter of contrast. Long drives will cease to be dreaded, both by the passenger and the driver, for again, the latter finds his work greatly simplified. He no longer finds it necessary to hunt out the most favorable parts of the road, to dodge rough spots, and to slow down when passing another car forces him off the pavement. He does not feel the need of stiffening up as he approaches a bad part of the road. In short, the driver can be careless without being made uncomfortable.



Heavy, closed car provided with balloon tires, indicating to what extent these abnormally large tires alter the usual appearance of a car

The new tire has a whole list of good qualities, and a few bad ones. Of the latter, two are quite bad and two are relatively unimportant. The worst feature is made most evident to the passenger in dry weather on dirt roads. The big tires kick up an amount of dust that is described as "terrible." In muddy weather they can easily outdo the common high-pressure tire in splashing mud and water. On the other hand, both of these nuisances are rapidly disappearing as our mileage of paved highways increases.

A lesser drawback is the necessity of equipping the tire with some form of snubbers. Unless this is done it will be liable to develop a sort of galloping action like some of the almost-extinct "Toonerville Trolleys" of yesteryear which were balanced at their middle on a single truck. Again the new tire appears to be far more sensitive than the old to improper alinement of the front wheels. The proper amount of toe-in or gather must be arrived at with some care.

Will fuel consumption be increased? Evidently it will, but the increase is very slight, compared to what

Close up view of a balloon tire, showing how it wraps itself around stones and other road irregularities instead of riding over them

one would expect with a 7½ inch tire apparently clinging to the road as it runs. Observations made on six taxicabs running a total of 20,000 miles on 7½ inch balloon tires showed an average of 13½ miles per gallon. This compares quite favorably with a larger number of similar cabs using 33 x 4½ inch tires with 70 pounds pressure.

Steering under certain circumstances may be slightly harder with the large tire. Naturally it is much more difficult to turn the front wheels when the car is standing and somewhat harder to maneuver at low speeds. The tires have a larger contact with the road and therefore cling harder. However, in crossing trolley tracks at an angle so sharp that it is nearly parallel the front wheels are not deflected by the rails in any measure.

Not only is the low pressure tire comfortable for the passenger, but it is equally "comfortable" for the car. A million little jolts are swallowed up by the tires every mile and get no closer to the car body than these large rubber shoes. Car life is extended. It is a safe venture to say that in a few years when the low pressure tire is very generally in use crystallized axles will be rare. The shocks due to road unevenness that are carried forward from high pressure tires to the transmission are absorbed by the new tire. This saves the transmission and contributes toward making the car ride more easily. The effect of riding over balloon tires, it is stated, is something like that obtained by jumping from a small inexpensive car to a large heavy car of long wheel base.

Skidding is practically done away with in the case of the car equipped with balloon tires according to the manufacturers. In another way danger is greatly lessened. Tests have proved that even at a rapid rate of speed a puncture or blowout with "balloons" is safe where with ordinary pneumatics the car would swerve and in all probability strike some object.

Touching upon general durability, the performance of balloon tires under average road conditions has, according to the claims of the manufacturers, proved that they possess a surprisingly great degree of ruggedness. For instance, a four-ply 7½ inch test tire gave out only after first having worn through the breaker and three of the plies. Furthermore it continued to run on the single remaining ply for a long distance before finally blowing out. Many of these tires have run their entire life with no tread cuts whatever. There have been cases where balloon tires after 7500 miles of service could when washed up be taken for brand new tires. It is even stated that these tires have been run miles when flat without damage to either the case or tube.

The explanation of the excessively low rate of wear shown by the low pressure tire is found in the fact that it is not held so taut as the other. A little thought will make evident the reason for this fact. If one wishes to sandpaper a piece of rubber he will naturally prefer to have it held in a taut flat position. If one wishes to cut a tough string he will get someone to hold it and pull it out taut. It is the same with the tire. The higher the pressure of inflation the more easily the sharp stones of the road cut and abrade it. Furthermore the decreased abrasive tendency is not in proportion to the decrease of pressure.

Anyone who has slept on an air-inflated mattress can easily appreciate why a large tire having air at a low pressure is more comfortable. The first time he uses the mattress he will be quite likely to inflate it fully. In this condition the various bumps of his body corresponding in the analogy to the bumps in the road will carry more than their share of his weight. Later he will learn that the mattress should be only about two-thirds inflated. When he lies down on it every bump—his hips, shoulders, etc.—will sink into it permitting the hollow parts of the body to take up their own fair share of the load. If he turns over the mattress changes shape and follows him. The same is true of the balloon tire. This is why it "envelops" little bumps in the road that actually throw the wheel shod with a high pressure tire off the ground and deliver a shock to the springs and car.

There are problems of car design that will have to be worked out before the new tires can be used to best advantage. For one, fenders will have to be made with greater clearance. Axles may have to be lengthened. The new four-wheel brakes may have in the case of some cars to be redesigned. The new tires will in some cases raise the entire car higher from the road. Steering members may have to be altered.

Those who have ridden on cars shod with comfort tires find it very hard indeed to find words to describe the sensation produced by them. Floating through space seems to be about the nearest they can approximate the sensation. One experiences a new sense of detachment as if looking at a motion picture of scenery silently floating past the lens. In fact according to T. E. Hale, Manager of the Development Department of the Firestone Tire and Rubber Company, it is almost impossible to choose descriptive phraseology to drive home the wonderful effect that these tires have on the riding of the car.

With the Men Who Fly—III

Our Recent Achievements, the Pulitzer Race, Night Mail, the "ZR-1," and Commercial Possibilities

By Alexander Klemin
Associate Professor of Aeronautics, New York University

THE last few months in the history of aviation have brought forth a further series of astounding achievements. And it is a noteworthy fact that they are due to American energy and engineering skill. The one foreign pilot in the Pulitzer race fell far behind Lieutenant "Al" Williams, U. S. N., who won at a speed of more than four miles a minute, and who, but a few weeks back, attained even greater speeds. The Schneider Seaplane Cup is now in the United States, brought home by a Navy team winning in European waters with another Curtiss ship. It is the United States Postoffice Department which is responsible for a conclusive demonstration of the possibility of night flying on regular schedule. The "ZR-1" is a derivative of German practice, it is true; nevertheless, it is the Navy Bureau of Aeronautics which has had the courage to revive the construction of gigantic dirigibles, in the face of many disastrous experiences and general neglect of this type of aircraft. The Army Air Service may bemoan its lack of equipment and impotence due to small appropriations, but the United States holds most records and leads in technical development. Self-congratulation is certainly permissible, particularly as these events are more than records—they are definite milestones on the road of complete conquest of the air.

The Pulitzer Race

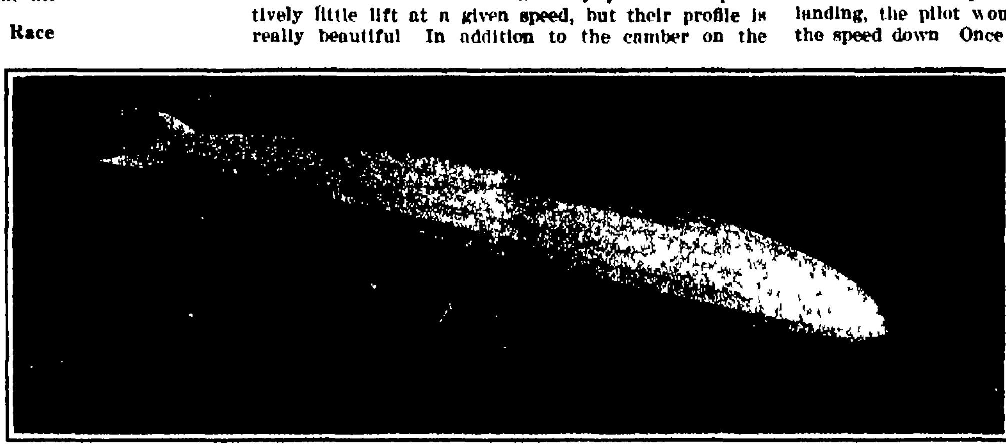
The St. Louis meet is rightly spoken of among airmen as "the greatest in the history of flying." St. Louis business men and bankers had spent over \$270,000 in preparing a suitable airdrome and offering prizes to the value of several thousand dollars. They were well rewarded for their efforts. Three hundred airplanes crowded the field, which an average of 50,000 spectators visited each day, including military attachés of foreign governments, army and navy officers, Congressmen, pilots, airplane manufacturers and operators. The "clou" of the meet was the great Pulitzer Cup race, reserved for the last day, which developed new speed records.

Lieutenant A. J. ("Al") Williams, formerly pitcher for the New York Giants, won the race in a Curtiss-Navy racer at an average speed of 243.67 miles per hour over the triangular course of 200 miles. Lieutenant H. J. Brow in a similar machine averaged 241.78, and Lieutenant L. H. Sanderson of the Marine Corps, flying a Navy Wright plane of 750 horsepower, was third with a speed of 230 miles per hour. Of the seven picked entries, Navy pilots won the first three places. Not a casualty or even a broken wire marked the race itself—a striking tribute to the growing safety of the airplane.

More than 100,000 paid to see this race and they got their money's worth. When a bomb started the race, the pilots swooped into the air like bullets. The machines seemed to flash across the course. On the last heat, in going round the pylons, pilots banked their machines so sharply that they seemed to rest in the air on their wing tips. When Al Williams went round the course he felt sleepy. On turning pylons his brain refused to function for several seconds. On the last leg he forgot he had finished and went round the course again.

The Winning Ship

There was no betting at the St. Louis meet. There must be superlative skill in piloting, but once the very highest point of piloting skill is reached, there is little scope for the superiority of one man over another. The planes must be in perfect condition. But, granted these two factors, the sporting element is very largely eliminated. Speed in airplane racing is more dependent on basic engineering skill and calculation than even with motor boats or racing cars. The secret of the Curtiss-Navy racer's victory lay in its perfect engineering. In basic principle the airplane has changed very little from the first Wright biplanes. A better wing, but still an inclined plane, provides sustention or lift; the same type of internal combustion motor, acting through the same type of propeller, overcomes the drag or air resistance; the same structural elements are present; practically the same system of air control. But what tremendous difference in the results attained! The secret of the difference lies in the tremendous refinement of each separate element. The Wright brothers were lucky to obtain 40 horsepower from their motor, which weighed nearly 200 pounds. In the race the Curtiss D-12 engine undoubtedly the most wonderful racing motor in the world, developed fully 500 horsepower, yet it weighed well under 700 pounds, and its area, projected on a plane at right angles to the line of flight, is but a few square feet. In the modern racer or fighting plane there is a tremendous concentration of power. The Curtiss racer weighed only 2097 pounds—not much more than four pounds per horsepower—and with this tremendous power the supporting surface is reduced to the minimum—148 square feet. Less area and but a few hundred pounds more weight than the Wrights flew with when their motor developed but 40 horsepower and 40 miles an hour was a high speed. The wings of the racer are thin of camber; they provide comparatively little lift at a given speed, but their profile is really beautiful. In addition to the camber on the upper there is a slight camber on the lower surface, giving the eye a definite impression of "streamline," of offering the very least resistance to motion of any sustaining surface ever designed. And the aerodynamical laboratory shows indeed that their efficiency as measured by the ratio of lift to resistance is over 20 to 1. In the early days of aviation 11 to 1 was considered good. Gone is the forest of struts and wires of biplane structures of early days. The wing bracing is now reduced to a minimum—a small I-shaped strut and three streamline wires on either side and direct attachment to the fuselage in the center. The body of the airplane is beautiful in its streamline form, no part of the engine projects—it is all carefully cowled in—even the exhaust stacks are housed in a wing-like covering, and the pilot's cockpit is such that the air flows past it with a minimum disturbance. The chassis must still have rubber cord to absorb the shock of landing, but the entire system of shock absorption is housed within the wheels themselves, removing all harmful air resistance. The propeller is no longer a thick wooden blade, but a thin duralumin forging, thinner and more efficient than is possible with the most carefully designed propeller in oak or mahogany. There is no clumsy automobile type of radiator in evidence. The engine works continuously at full power and must be cooled, but the cooling water circulates through the wings themselves and is therefore freed of its heat without imposing any resistance to motion. By the use of duralumin, strong as mild steel and one-third the weight, the weight of the entire structure is reduced to a minimum, explaining largely the extraordinarily low weight per horsepower it is possible to obtain in the modern racer. It is the refinement of each minute detail, the perfect coordination of aerodynamic efficiency with light structure and light and compact power plant, that won the Pulitzer race rather than any radically new development.



Our giant dirigible "ZR 1," now known as the "Shenandoah," in flight, propelled by six engines of 300 horsepower each

Is There a Limit to Airplane Speed?

The participation of the Army and Navy Air services in the Pulitzer races involves great expenditure. But it is fully justified. The general progress in performance, aerodynamics and construction evolved under the stress of racing conditions is immediately carried over into the construction of practical fighting ships. Ultimately it will be carried over into the field of commercial aviation. If 300 miles an hour were commercially possible, New York to San Francisco would mean less than 10 hours flying, a possibility which would certainly have value. The question arises whether the practical limit of airplane speed has now been reached. From the point of view of the engineer it undoubtedly has not. It is true that the utmost refinement has already been attained in structure, in the use of light materials, in aerodynamic streamlining, in improving wing efficiency and cutting down wing area, and in the power plant. We could fly faster with smaller wings, but then the landing speed would become prohibitively high. But there are still avenues of progress. Suppose a wing could be practically used in which the camber of thickness could be varied at will. Camber is almost synonymous with lifting power. In making a get-away or on landing, the pilot would use a heavy camber to keep the speed down. Once in the air the camber would be reduced to a minimum so as to secure the maximum speed possible. It is difficult enough to build an airplane wing structure which shall be safe and adequately rigid without any moving contrivances, but still there seems no inherent reason why a practical method of camber control should not be developed sooner or later. Variable area has the same basic advantages as variable camber and may be another method of attacking the same problem. Yet a third method of varying at will the lifting capacity of the wing is in the famous Handley Page slotted wing, whereby the opening of a carefully shaped slot in the leading edge of the wing in combination with the pulling down of the trailing edge, produces extraordinary results, increasing the lift in some cases by 80 per cent.

It does not seem possible to diminish the resistance of the fuselage very greatly, but it is quite feasible to think of the landing gear being withdrawn in flight into the fuselage with a corresponding decrease in head resistance and increase in speed, provided always that a simple and entirely dependable mechanical contrivance can be found. In its present form the aviation engine is not susceptible of indefinite improvement in lightness or size for a given power, but experiments are being carried out both in Europe and the United States on what might be called crankless engines, in which the elimination of reciprocating motion has resulted in all the advantages of a gas turbine, namely, extreme compactness and light weight, without its inherent difficulties.

Another line of approach in the securing of tremendously high speeds lies in flying at altitude. The supercharger can be made to maintain the full power of the engine at altitudes of 30,000 feet. Granted this fact, the speed of an airplane can be increased quite appreciably by flight at altitude, where the air offers less sustention but also less resistance. The airplane, to achieve high speeds at ground level, must fly at a small angle where the lift is small, and at this angle the wing is inefficient—its resistance is high in proportion to the lift. At altitude, the low density of the air and the correspondingly smaller lift will permit the machine to be flown at a greater and more efficient angle to the line of flight. The design of an altitude machine involves a thorough understanding of the somewhat intricate aerodynamic principle involved. It also involves the consideration of an adequate supply of air at atmospheric pressure

to pilot and passengers, and electric heating in the great cold of the upper atmosphere. But there are no insuperable problems here.

If these new lines of attack are courageously approached, when the present methods of improvement have been exhausted, speeds of over 300 miles an hour will certainly be within reach.

But perhaps there is a limitation from the human point of view. We have seen that Lieutenant Williams suffered partial loss of consciousness in going round the pylons in the Pulitzer race. When turning the airplane banks, with its lower wing toward the center of the turn, much after the manner of a bicycle going round a corner, centrifugal force tends to throw the plane away from the center of the turn, but the banking or lateral inclination counteracts this so that there is mechanical equilibrium. However, centrifugal force acts not only on the inanimate elements of the airplane, its wood, metal and canvas, it acts also on the body of the pilot, on his frame, which is pressed against the sides of the fuselage, and on the blood which circulates within his body. A simple effort of the imagination will show that the blood will flow away from the brain into the lower parts of the body. In Williams' case this centrifugal force lasted but a moment, and consciousness returned. A more severe effect and consciousness might not return; in other words death would result. This forms a very weighty argument in favor of the possible limitation of airplane speed, but here again mechanical ingenuity seems likely to overcome all obstacles. Gyroscopic or other controlling devices might be used to obtain flight on an absolutely even keel and in a straight line, the rapidity of turn might be limited, and in commercial flying there is anyhow no necessity for anything but the most direct flight between any two points, without violent maneuvers.

Night Mail

Less spectacular than the thrilling St. Louis races, the four-day test runs for night mail between New York and San Francisco have perhaps even a greater importance. The Air Mail Service completed with but little delay the arrangements for illuminating the night leg of the route between Chicago and Cheyenne, Wyo. In a series of eight flights, East to West and West to East, the mail planes maintained an average of 28 hours for the whole run. In spite of bad weather and occasional fog, the test ran with the greatest precision, due to the splendid ground organization which was on a par with the extremely thorough lighting arrangements, over the 885 miles of the night leg. Regular Air Mail planes were used, namely, old war time DH ships, rebuilt to suit the needs of the service. Assistant Postmaster General Paul Henderson, in charge of the work, summarizes the results of these tests in words which cannot be improved upon:

"Our tests show that aircraft may be operated at night with certainty, safety and regularity. This opens the door for a new and wide use of aircraft. The dark hours out of the 24 are those most important to the business man from the point of view of the expeditious transportation of his letters, his money, his merchandise. Although airplanes run much faster than trains, except in certain peculiar combinations of distances, part, if not all, of this advantage over trains has heretofore been lost, due to the fact that the train ran 24 hours a day, while the airplane had to stay on the ground at night.

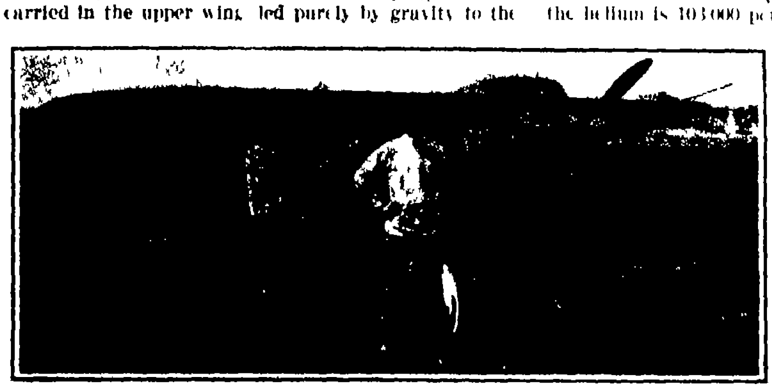
"I really believe that within a relatively short time all important commercial and industrial centers of the United States will be connected up by lighted airways, over which mail, express and other important movements will be made at night, always providing that the distance between such centers exceeds 500 miles, and does not exceed 1200 to 1500 miles.

"There are in the United States scores of potential over-night routes, the outstanding probably being New York and Chicago. Aircraft will fly from New York, leaving after dinner in the evening, arriving in Chicago just before dawn."

Problems Still to be Solved by the Air Mail

The Air Mail has by no means solved all its problems. Its equipment is to be replaced by more modern ships. Three experimental ships have been built by the Glenn L. Martin Company, the Curtiss Aeroplane & Motor Company and the Aeromarine Company and are being tested out. These ships are based on the experience of the air mail pilots and superintendents and on the records of such flights as Macready and Kelly's and Maughan's across the continent. Lower landing speeds, more rugged landing gears, greater accessibility to the power plant and a larger useful load or carrying capacity have been sought for and attained. To eliminate gasoline system troubles, in all three ships gasoline is carried in the upper wing, led purely by gravity to the carburetor and thus eliminating gasoline pumps and complicated systems of leads. But in addition to better equipment the Postoffice has yet to complete its meteorological service arrangements, to install a practical system of wireless communication between the pilot and the airdromes at all fields, to build ships which will land slowly and not spin and yet fly fast. And if the service is to be entirely independent of weather, some sort of stabilizing device which will enable the pilot to fly in fogs without losing an even keel or circling round and round, is still to be produced that will be simple enough and cheap enough to merit extensive use.

But whatever detail improvements are yet to come there is no doubt now that the Air Mail has definitely established itself as a permanent factor, and that its extension throughout the United States is only a matter of time.



Curtiss-Navy racer which has recently developed speeds close on to 270 miles per hour

The Giant Dirigible "ZR 1"

The supremacy of the airplane is not left unchallenged, however. After the war the disastrous fate of many of the German Zeppelins, their inability to resist attack from airplanes owing to the inflammable hydrogen with which they were filled and the ease with which they perished in stormy weather, particularly when going in or out of hangars, led to their general abandonment by European governments. It required great courage on the part of the United States Navy to resume their development and to invest a sum estimated variously as between $1,500,000 and $3,000,000 in the construction of the "ZR 1," now termed the "Shenandoah," at the Naval Air Station in Lakehurst, N. J. The enormous ship is one of the largest dirigibles ever built. Its length is 680 feet, diameter 78 feet, and its gas capacity is 2,150,000 cubic feet of the non-inflammable gas helium. The huge girder structure of the ship contains twenty cells of cotton fabric lined with goldbeaters' skin, a bovine intestinal product unsurpassed for its imperviousness to gas leakage combined with extremely light weight. The structure is made of duralumin, an alloy of aluminum, copper and manganese, which seems to threaten the supremacy of steel in many fields of engineering. The power plant consists of six Packard engines developing 300 horsepower each. A cruising radius of 4700 miles is possible with a full crew of [illegible] men and equipment, and the total lift of the helium is 103,000 pounds, while the dead weight of the airship is 71,360 pounds.

The "ZR 1" has so far made every voyage a successful one, and its longest trip to St. Louis was a non-stop flight of 2200 miles, during which an average speed of 60 miles an hour was maintained. On the return leg of the journey from St. Louis races to its home at Lakehurst, New Jersey, the "ZR 1" covered the 7[illegible]5 miles between Chicago and Lakehurst in twelve hours flat and at a fuel consumption of about five-sixths of a gallon of gasoline per mile. In fact $1[illegible]0 was the entire fuel bill—but a fraction of the cost of the coal for a limited train running the same distance.

Huge Barling bomber in flight, showing the arrangement of its power units, cockpits, wings and tail

Commercial Possibilities of Dirigibles

The extremely cheap cost of fuel, the apparently uniform success of the trial flights of the "ZR 1," the proposed transatlantic voyage of the "ZR 3," now being built at Friedrichshafen, Germany, for the United States Navy, the decision of the British Government to help finance the so-called "Burney" plan whereby an airship service is to connect Great Britain with Egypt and India and then with New Zealand and Australia—all these factors have strongly revived the interest in the commercial uses of dirigibles. Many large interests are studying the problem closely, and it is forming the subject of much discussion at air conferences and in the technical press. The question is one of tremendous complexity. The safety and possible regularity of service under all weather conditions, the economy of operation, the possible speeds and range, the enormous size and cost of the units which have to be employed, the traffic which may be reasonably expected over a given route, the tremendous capital investment required, the insufficient data on operating costs, the rapid depreciation and other financial factors are inextricably woven together. Careful analyses have been made both by European and American experts and have shown the most favorable forecasts, with the possibility of enormous profits based on apparently reliable and conscientiously made estimates. But there is nothing conclusive so far, and any dirigible undertaking must of necessity be a gamble on a huge scale. It is not possible within the scope of one short article to study the problem with any degree of completeness. We can but set down a few of the complex factors which enter into the proposition.

Safety and regularity of service are perhaps the most important. Here the outstanding problems are the prevention of fire, adequate structural strength, and the handling of the airship in starting on a trip and on landing. The first problem is largely solved by the use of helium, provided helium, now costing some $100 per 1000 cubic feet, can be produced at a cheaper rate. Another plan is to use a cheaper hydrogen inflated airship with a small outer space filled with nitrogen or helium. The substitution of heavy oils for gasoline is another step in the direction of fire prevention. In spite of disasters in the failure of dirigible structures, such as in the case of the ill-fated "R 38," there is no doubt that an airship can now be made structurally strong enough to withstand all the effects of gusts when once in the air, although a dirigible may sway uncomfortably in heavy wind and be considerably harder to keep on its course than a speedy airplane. But the effect of wind becomes extremely difficult when it is sought to bring the airship in or out of a hangar. A small army of men is used to bring the "ZR 1" out of its shed, and even then there is no guarantee against a bad smash against the sides of the hangar. The mooring mast is perhaps the solution here. Mooring masts of gigantic proportions have been designed and built, to which airships can be attached in any weather and, pivoting round like a weathercock, will always place themselves

(Continued on page 72)

The Story of Steel—I

Amazing Growth of the United States Steel Industry in the Past Two Decades

THE story of steel is the story of the astonishing industrial development of the United States during the past quarter of a century The secret of that development is to be found in the opening up of the enormous deposits of ore in the Missabe range to the north of Lake Superior and the characteristic American operations on the grand scale in mining transportation smelting and fabricating into steel by which the contents of that treasure house of Nature s providing have been transformed into ten thousand commodities to meet a world wide demand

The magnitude of the steel industry expressed in numerical statistics makes only a shadowy impression to the mind these figures have to be reduced to some concrete form if any adequate impression is to be conveyed Thus the statement that the United States in the year 1918 mined over sixty nine million long tons of ore fails to convey an adequate impression of the vastness of this total but if we should see the entire ore production for that year piled up in a single heap, we would get an instant comprehension of its meaning by comparing it with familiar objects in the landscape The mind is confused by large numbers but it grasps quickly the sight of large concrete quantities The statement that a wagon holds 30,000 000 grains of coal would give a person a very hazy idea of the actual quantity specified but he would comprehend the quantity at once if he were told that it represented two tons The larger unit of weight would reduce the count to a figure readily within his mental grasp

It is because of the above conditions, that the SCIENTIFIC AMERICAN makes such frequent use of the comparative diagrams which have so long maintained their popularity with our readers

On the front page of this issue we give a graphic comparison of the statistics of the steel industry in the past twenty years We wish to make it clear that we have chosen for comparison that year in which the quantities of ore coke pig and steel etc reached their highest figure This occurred in 1918 that year of feverish industrial activity As we go to press the statistics for 1923 are not yet fully available but there is every indication that they will be fairly close to those of the earlier year The working forces and general equipment which handled and produced the enormous quantities of 1918 are available probably in even greater measure today Hence the output of 1918 may be very fairly taken as the measure of our maximum capacity in 1922

Referring to the diagram it should be explained that the quantities for 1902 are shown in solid black and those of 1918 in a lighter shade but it should be remembered that while the vertical columns, etc of 1902 represent cubical contents the outlines for 1918 represent the increase in each case, by superficial area only Thus in the case of the column showing the quantities of coke if we take the superficial area of one side of the 1902 output as the basis of comparison the superficial area of the larger surface shown behind it will represent to scale the increase in the total quantity of coke used in 1918, a year of unusual activity

Coke

Now we find that in 1902 the amount of coke used in the furnaces of the United States was 16 000 000 tons Coke is so light in weight that if the 16,000,000 tons were built up in a column 400 feet square on the base it would reach an altitude of 6 500 feet No work built by human hand has ever been erected that would give us by comparison with this column, any idea of its magnitude for if the base of the column were situated at sea level a person at the top would look down on the summit of Mt Washington New Hampshire, and he would find that it overtopped every mountain in this country east of the lofty range of the Rocky mountains

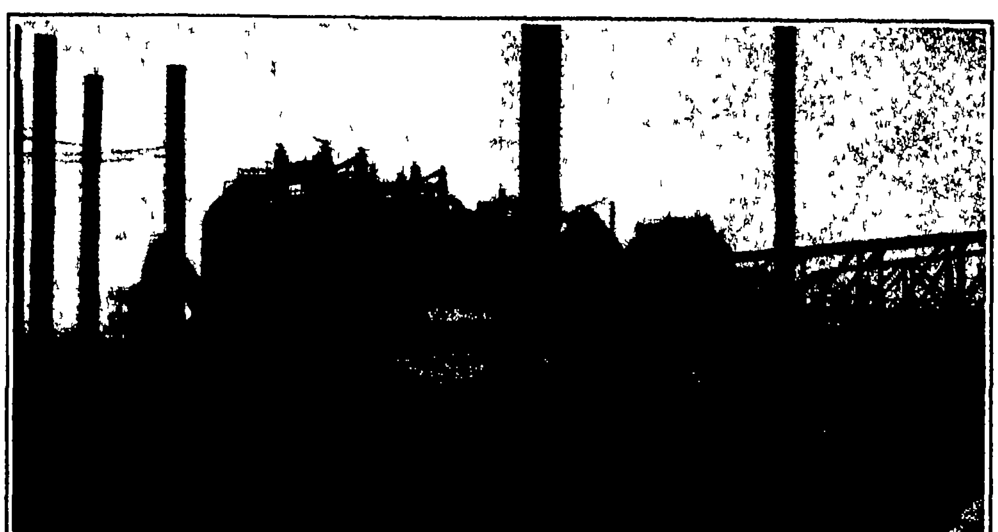
Sixteen years later, the coke used in our furnaces had reached 45 703 594 tons, which would represent also the consumption in 1922, if our furnaces had been worked to maximum capacity But in 1922 the steel industry had not yet recovered from the depression which began with the great industrial slump of 1919

Limestone

The limestone used for fluxing purposes in the blast furnaces amounted in 1902 to 9,490 000 tons, which would be represented by a column 5500 feet high on a base 200 feet square In the year of maximum production there was consumed a total of 19,208,403 tons of limestone The purpose of the limestone is to form a flux with the impurities in the blast furnace charge, which being lighter than the molten pig iron floats on the surface of the iron and may be tapped off separately Twenty years ago slag thus formed was more or less of a nuisance and was hauled away to be dumped as one of the wastes of steel making Increasingly during the past two decades slag has come to be recognized as useful material for the ballasting of railroad tracks the building of roads and more lately and above all as a valuable constituent in the manufacturing of cement—an industry which has grown to vast proportion in this country and is rapidly supplementing, if not supplanting steel in buildings and bridges

GROWTH OF STEEL INDUSTRY IN PAST TWO DECADES

	1902	1922	1918
Ore mined in United States	34 636 121	47 128,572	69 658 278
Coke used in furnaces	16 000 000	29 218 893	45 703 594
Limestone	9 490 090	11 719 638	19 208 403
Pig iron	17 821 807	27 219 904	39 054 644
Rails	2 947 933	2 171 776	2,540 892
Plates and sheets	2 655 409	7 968 397	8 799 135
Wire nails 100-lb kegs	10 982 246	15 068 330	12,279 800
Cut nails, 100-lb kegs	1 633 762	810 206	418 811
Structural shapes	1 300 326	2 718 768	2 849 969
Steel ingots and castings	14 947 250	35 602 926	44 462 432



Four furnaces, with their hot blast stoves, at the Illinois steel works

Iron Ore

The iron ore mined in 1902, amounted to 34 636,121 tons. This amount if it could be piled up into a square column, because of the greater weight of the material would represent a much smaller mass than the 16,000,000 tons of coke If it were built up on a base measuring 200 feet square, it would reach to a height of 6500 feet The larger output of iron ore shown in our drawing occurred in 1918 when there was mined 69 658,278 tons, of which by the way, 40,396,711 tons came from the great Missabe range

Pig Iron

All the great mass of materials above referred to and shown in the first three columns of the illustration were consumed in producing respectively 17,821,807 tons of pig iron in 1902, and 39,054,644 tons of pig iron in 1918 Due to the industrial depression, from which there has been a gradual recovery, the total output of pig iron in 1922 was only 27,219,904 tons.

Steel Ingots and Castings

In the earlier years of the industry, the bulk of the molten iron, as it was run from the smelting furnaces, was cast into pig, but with the development of modern methods, the preliminary casting into pig has been practically abandoned in favor of transferring the molten iron directly to the mixing machines and the Bessemer converters and open hearth furnaces for conversion into steel The total output of steel ingots and castings in 1902 was 14 947,250 tons Of this total 9,138 363 tons was converted from "pig" into steel by the Bessemer process and the balance by the open-hearth process In 1918, the output was 44,462,432 tons During the past twenty years, the proportion of open-hearth to Bessemer steel has been steadily increasing, so that in 1922 only 9,370,236 tons out of the total output of the blast furnaces was converted by the Bessemer process

Steel Rails

It is a curious fact that, in spite of the great increase in production of the various finished steel products, the output of steel rails in 1922 was actually less than that of 1902 the respective totals being 2,947 933 tons in 1902 and 2,171,776 tons in 1922 The explanation of this decline is to be found in the fact that, twenty years ago, we were still in the midst of an era of great expansion of our railroad system, the total amount of new lines constructed in 1902 being 5076 miles Shortly thereafter as the needs of the country were supplied, there commenced a falling off in new construction so that today the total of new work is very limited indeed That the output of rails is as high as it is may be set down to the fact that the rail renewals on our 260 000 miles of track are sufficient to keep our rail mills fairly well occupied The rail production of 1902, if formed into a single rail of standard proportions, would be 81 feet high with the same width on the base and the head of the rail would have a width of 43 feet A rail built on these proportions would extend for one and one-fifth miles before the year's total tonnage of rail had been included

Plates and Sheets

The finished product in the steel industry which bulks the largest is that of plates and sheets, the ouput of which has grown in the past twenty years from 2 655 409 tons in 1902 to a maximum output of 8,799 135 tons in 1918 Even this last figure was exceeded in 1920 when the output was 9,337,680 tons The growth in plates and sheets is shown graphically on our front page engraving, where the 1902 tonnage is represented as rolled into a single sheet of No 30 standard gage, which would cover the territory shown in dark shade. The larger output of 1918 would cover the area of lighter shade

Furnace Capacity

The two furnaces which we have shown represent the total capacity of all the furnaces in the country, respectively in 1902 and 1918. The furnace shown in black represents the capacity in 1902 The furnace output today is more than double what it was then; and this brings out the interesting fact that the total number of furnaces has shown only a moderate increase of from 406 in 1902 to 459 in 1918, and this in spite of the fact that in the interval the total output of pig had increased over 100 per cent This is explained by the fact that the average furnace of today is far larger and more efficient than it was twenty years ago

Solving Rapid Transit Congestion by the Moving Platform

AS OUR readers are aware, in years past we have given much attention in these columns to the Moving Platform method of transportation. We have always believed, and have so stated, that unless some mechanical or operative difficulties should develop, this system, because of its enormous capacity, presents an ideal solution of the problem of congested local rapid transit. On the other hand, we have been alive to the possibility that the passenger might find difficulty in stepping from a stationary to a moving platform and have realized that this could be determined only by actual test in a full size installation.

In order to subject the Moving Platform to such a full size operative test Mr. H. S. Putnam, the author of the electrically operated platform which we illustrated in our issue of January, 1923 has recently constructed a complete platform in Jersey City, and for several weeks has been carrying out a series of tests to determine the efficiency of the electrical system by which it is run, and secure reliable statistics as to the weight, resistance and horsepower required, for a given length, speed and passenger capacity of Moving Platform built and operated according to his system.

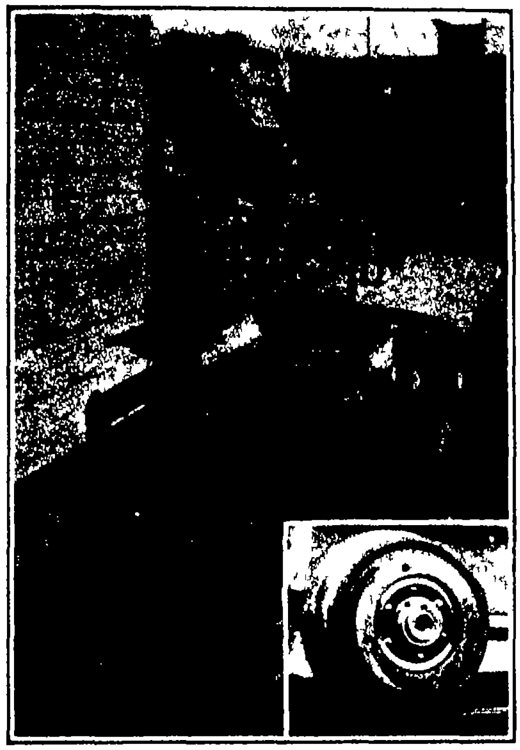
A member of the SCIENTIFIC AMERICAN staff recently visited the Jersey City installation with the thought in mind to satisfy himself on the important question as to whether it was physically possible to walk across the *successive platforms to the seats and return from the* seats to the stationary platform without any stumbling or confusion. He found that by facing the direction in which the platform was traveling and leaning slightly forward, it was a simple matter to step successively to the 3-6- and 9-mile per hour platforms and take a seat and that by leaning slightly backwards and still facing in the direction of travel it was equally a simple matter to return without stumbling or discomfort to the stationary platform. One handles oneself as one does in stepping on to and off an escalator.

We now give the data which have been secured as the result of some two thousand tests made on the Jersey City installation, together with the estimates of capacity, horsepower and cost of operation as based upon the data so secured.

The capacity of the Moving Platform as compared to *present systems of transportation is practically unlimited* as shown by the following figures.

The schedule capacity of the present shuttle service on the 42nd Street subway is 4,400 seats per hour. The proposed Moving Platform on 42nd Street will have a capacity of 35 640 seats per hour. When overload capacity is considered the present shuttle service has a maximum capacity of 17 600 passengers per hour as compared with 100 920 overload capacity on the Moving Platform.

The schedule for the operation of the East Side subway at Grand Central Station during the maximum hour calls for the operation of 7,200 seats per hour in the local service, and 13,200 seats per hour in the express service, making a total of 20,400. This because of delays, is reduced from 10 to 15 per cent during heavy rush hours.



Upper view: A section of the high speed platform, showing the primary element of the motor straightened out between the rails, and the secondary element mounted along the bottom of the train. Lower view, one of the ball bearing wheels

The local service on the New York subways is used almost exclusively as a feeder to the express service. If the subways could be relieved of the operation of their trains in local service these tracks and the equipment could be used for express service at an actual reduction *in the total cost of operation* and with an increase of fully 100 per cent in the number of revenue-producing passengers carried. Assuming the strictly local passengers only carried on the subway to be 20 per cent, and assuming a 10 per cent reduction in capacity from schedules during rush hours the maximum capacity of revenue producing passengers per hour on the subway is now 14 000 seats per hour, and 54 000 including the maximum standing loads. By building parallel subways with a Moving Platform and with the local train service converted into express service the maximum seating capacity in express service would be increased to 26 400 per hour and the maximum standing load to 106 000 per hour. The total capacity of the subway with the addition of the Moving Platform would be increased from a total of 20 000 seats per hour to 63 000 seats per hour and the maximum peak standing load would be increased from 74 500 per hour to 212 500 per hour. These results can be obtained by constructing a Moving Platform paralleling the existing subways, or the new subways when they are built at a cost of but from 20 to 25 per cent of the cost of a new 4 track subway and with an increase in operating cost of but from 12 to 15 per cent of the cost of operating a 4 track subway.

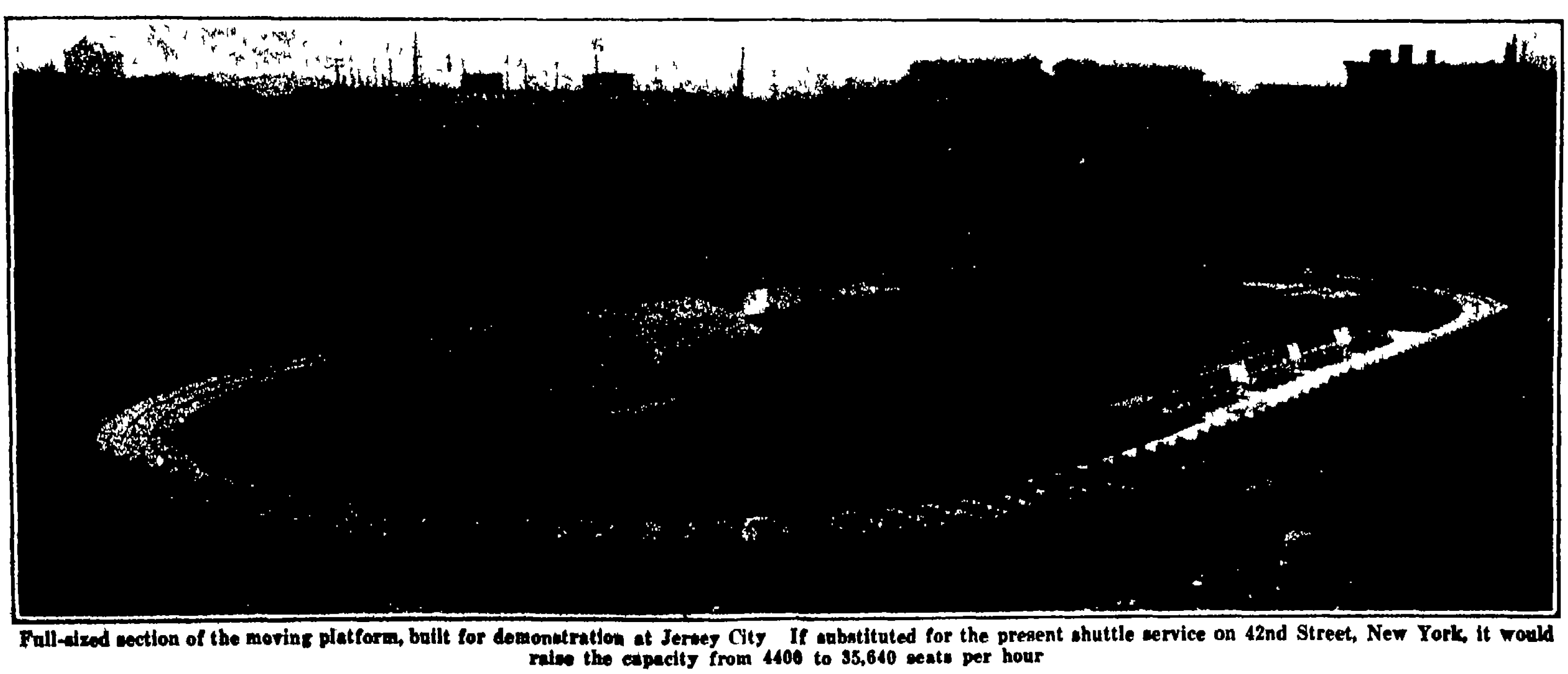
The distinguishing characteristic of the electric system of propulsion as compared to other systems is the method used to propel the car. Instead of mounting a complete motor upon the car and transmitting mechanical power therefrom through gears to the wheels the elements of a three-phase induction motor of the squirrel cage type of winding are separated the part corresponding to the stationary (primary) element of the motor being straightened out and placed at intervals in the roadbed between the rails while *the part corre*sponding to the secondary or revolving element is spread out and forms a continuous short circuited secondary mounted on the bottom of the car. The primary elements of the motor thus placed between the rails are magnetized by three-phase alternating currents delivered to the windings through cables run in ducts in the roadbed. The primary elements by induction magnetize the short circuited secondary which extends along the bottom of the continuous line of cars above the rails the result being that the cars are propelled by the magnetic force thus created between the shifting field of the primary and the induced current in the short circuited secondary *on the bottom of the car*.

The speed of the Moving Platform approximates three miles per hour for the low speed platform six miles per hour for the intermediate platform and nine miles per hour for the high speed platform upon which the seats are mounted. The electric system will operate at nearly synchronous speed and it is proposed to use identical construction for the electrical elements on the three platforms. The different speeds of the platforms are secured by operating the intermediate platform at double the frequency of the low speed platform and the high speed platform at three times the frequency of the low speed platform. The movement being continuous there is no jolting of the passengers.

Gassing Peach Borers

THE New York Agricultural Experiment Station at Geneva *reports that fruit growers have been much* interested of late in the use of a chemical compound for peach borers which under proper conditions seems to give quite satisfactory control of the pest. This compound goes under the name of paradichlorobenzene and is a common and well known chemical product which can be secured at a very reasonable price from any reliable dealer in insecticides.

The preparation comes in the form of crystals which are quite volatile and give off a characteristic odor. The usual procedure is to remove any weeds or grass growing around the crown of the peach tree and then place one ounce of the crystals in a ring about the tree. The soil is then drawn over the crystals and banked up slightly about the tree. The gas which is given off from the crystals penetrates the burrows of the peach tree borers and kills the young borers.



Full-sized section of the moving platform, built for demonstration at Jersey City. If substituted for the present shuttle service on 42nd Street, New York, it would raise the capacity from 4400 to 35,640 seats per hour

Life on Board U. S. S. "Colorado"

Changes in Naval Sea Service from 1856 to 1923

By Capt R R Belknap, U S N, Battleship Colorado

THE Colorado is a super dreadnaught of 32,600 tons total displacement, 28,000 horsepower, 21 knots speed and eight 16-inch guns in her main battery. She is 624 feet long, 97¼ feet beam and draws 31 feet in draft of water. Her complement comprises 60 officers, 1260 naval enlisted men and 75 marines. The Colorado, the West Virginia, likewise nearing completion, and the Maryland, commissioned in 1921, three sister ships, are the most powerful and modern battleships in the world.

The new battleship Colorado is the third ship in the American Navy to bear that name. The first, named for the Colorado River, was a wooden steam frigate of 3400 tons displacement, mounting 40 guns, launched at the Norfolk Navy Yard on June 19, 1856. She was one of the larger vessels of her time in our Navy, corresponding to the intermediate or [illegible]0-gun ship of the days before steam and to the armored or battle cruisers of later periods. Like others of her type she was a full rigged ship, ordinarily making sea passages under sail alone. As the single screw propeller would then be a drag, it was fitted to uncouple and be lifted clear of the water.

The state of Colorado gave its name to the second man-of-war Colorado. She was one of six armored cruisers authorized three at a time by Congress in 1899 and 1900, of 13,680 tons displacement, carrying four eight-inch guns in two turrets, fourteen six-inch, a score of smaller calibers and two underwater torpedo tubes. Her Niclausse boilers and four-cylinder triple expansion engines driving twin screws developing 27,000 horsepower attained a maximum speed of over 22 knots. Her ship's company numbered 910. President Roosevelt once witnessed target practice on board and took dinner with the crew in the General Mess, giving his signed photograph as a souvenir. On December 1st, 1916, her name was changed to Pueblo, after the second city in Colorado, and under this name she served in the Cruiser and Transport Force in the World War under Captain G. W. Williams, escorting transports across and after the Armistice bringing 10,1[illegible] troops home.

What remarkable changes have taken place between the first U.S.S. Colorado, built in 1856, and the latest super dreadnaught of the same name. As a general measure of size, the 3400 tons displacement of the old frigate is grown nearly tenfold; the old seasoned oak hull is now all steel, of thick armored sides and many watertight compartments; full sail power has utterly disappeared, and its lofty, wide spreading, slender spars are replaced by tower-like cage masts topped by large fire control stations; the symmetrical tracery of standing and running rigging is now represented by the bristling, lofty and oddly placed radio antennae.

Down below in the old frigate rectangular boilers of copper furnished steam at only 25 pounds pressure to a thumping, cumbersome, slow moving horizontal reciprocating engine, which by means of a single screw drove the ship at ten knots at best, where now oil burning, tubular steel boilers generate 200 pounds steam pressure for the delicately balanced turbines adjusted to the thousandth of an inch, which without the least tremor of vibration and with scarce a sigh of sound spin at about 2,100 revolutions a minute, generating alternating electric current which by a twelfth reduction turns four screw propellers 171 revolutions for a ship speed of 21 knots.

For illumination oil lamps and candles are retained only for emergency should electric light fail, and the present brilliant searchlight had no like in the frigate's days. In the day's work the shrill pipe and hoarse voice of the Boatswain's mates passing the word along the open sweep of decks is all but replaced by speaking tubes, telephones and other instruments, electric or mechanical, for transmitting communications to scores of separated spaces all through the ship. And at meal times while Navy beans still hold their own, salt pork, plum duff and hardtack have given place to refrigerated meat, vegetables, bread, pie and ice cream.

High velocity, anti-air craft gun of which the Colorado carries eight on her superstructure

Of all changes, however, the greatest is in the kind of demands made upon the crew and officers. In the frigate Colorado the yards were hoisted and braced about, the sails were reefed and furled, the anchor weighed, the boats rowed and hoisted, the ship steered, and stores whipped on board—all by hand. Handling sail, besides making strong bodies, taught eye, hand and brain to work nimbly together. In stormy weather a seaman aloft at a dizzy height could work with both hands and exert his full strength while holding on by his knees or even in some incredible way by a grip with his belly. In muscle and wind, in practiced familiarity and dextrous skill and in observant eye and ready resourcefulness the square yard sailor was an athlete, but he had a contempt for machinery and of anything savoring of Science. Seamanship was to him an art, beyond expounding or improving by books.

In contrast, most of the demands for power in the modern battleship Colorado are met by machinery. Where formerly two helmsmen, or four in heavy weather, handled a spoked steering wheel, to move the tiller by means of rawhide ropes, there is now no wheel at all, the modern steersman instead with one hand pushing an electric control handle right, left or amidships with equal ease in any weather, causing electric and oil motors by means of heavy screw thread transmission to move the rudder accordingly. An electric windlass below decks inside armor lifts the ten ton anchors with ease and quickness, two large electric cranes hoist and swing the boats out or in and handle other weights and stores too heavy for the small derricks and winches installed at various points along the ship's sides, while most of the boats themselves, more than twice as large as of old, are gasoline-motor driven.

To serve the guns the old fashioned powder boy, shell whip, hand rammer and training tackles have been superseded by powerful electric contrivances. Exertion of human strength must, of course, be still required here and there in minor ways, but mostly by individuals seldom by masses of men as formerly was common in hoisting topsails, heaving around the capstan to weigh anchor or otherwise for a heavy drag. Instead now a high degree of technical knowledge and skill is needed in many specialties to control and use the numerous power appliances correctly and keep them in condition reliable for service.

Yet though athletic qualities are no longer needed for work aloft, a healthy body is essential to the healthy mind and a cheerful spirit needed for contentment and efficiency. The active open air, often strenuous conditions of naval life in all weathers and all climates both need and tend to make a strong as well as sound body, but as many of the specialties involve long hours below decks and as ship life is at best confining, the modern naval routine pays considerable attention to physical training, exercise and recreation in order to foster and maintain that combination of proficiency, attention, fidelity, responsiveness, initiative, resourcefulness, courage, endurance and recuperative power which is summed up in the term morale.

Length 624 feet, *beam*, 97 feet 3½ inches, *mean draft* 30 feet 6 inches, *normal displacement* 32 600 tons. *Battery* eight 16-inch, twelve 5-inch, eight 3-inch anti-aircraft. Two submerged, 21-inch torpedo tubes. *Protection* belt, 16 inch to 14 inch, turrets 18-inch to 9-inch, decks, 3 inch to 1-inch. *Underwater* four successive anti-torpedo spaces between outer hull and the vitals.

"Colorado," and her sister ships "West Virginia" and "Maryland" are the most powerful ships afloat

Left upper Looking aft, showing (foreground) the chase of two sixteen-inch guns, and astern a seaplane leaving the catapult mounted on the quarterdeck. *Right upper* The comfortable crew's reading room. *Lower left* Operating platform from which the Westinghouse turbo-electric drive is controlled. *Center* Looking aft from the maintop, showing the four after sixteen-inch guns and the crew saluting the flag as the "Colorado" (R. R. Belknap Captain) goes into commission. *Lower right* Forward end of one of the 8000-horsepower motors

The commissioning of our latest battleship "Colorado", the mightiest warship afloat

A Five-Hundred-Year-Old Roof

Preserving for Posterity a Noble Specimen of Medieval Carpentry

WESTMINSTER HALL, whose wonderful timber roof forms the subject of this story, is the most ancient of the venerable buildings in Westminster of which the Abbey is at once the largest and most widely known. The Hall, 69 feet wide by 240 feet in length was built a few years after the Norman conquest and its present walls are those which the Norman builders erected. The original roof completed (so says the Saxon chronicle) in 1099 was supported it is believed, by the side walls and by two intermediate lines of timber posts. This roof fell into decay, and King Richard II decided upon the erection of a new roof. Presumably, he gave orders that the wide span of 69 feet should be covered without any intermediate supports, such as the posts that helped to carry the former roof.

Westminster Hall 69 feet wide by 240 feet long, built 1099, was re-roofed in 1397. This magnificent specimen of medieval carpentry stands today, after 525 years of service. It has recently been reinforced by steel framing concealed in the original timber work

Whether it was by the King's order or not, we do know that the Master Carpenter (thought to be Hugh Horland) set about the daring task of roofing this great hall in one clear span from wall to wall *in timber*—an altogether unprecedented timber structure, both as to its size and the peculiarity of its design. No timber roof of such a span had been attempted before nor was any such attempted in the centuries of medieval roof construction that followed. Furthermore, because of the enormous size of the original timbers it is certain that the Westminster Hall roof could not be duplicated *in oak* today and this for the reason that oak trees of the size necessary to supply such timbers are no longer to be found: they were cut down centuries ago.

Hugh Horland who must have been of advanced age for he was in receipt of a pension "for his long and arduous services to the crown" began work upon the roof in 1394. He did his work well, for after enduring the storm and stress of over five centuries, the vast oaken fabric is standing today just as he planned and built it.

But perhaps it would be more correct *to say that, so far as* the eye can judge the roof is standing today exactly as he left it, for thanks to the destructive attack of a wood-devouring grub, called Xestobium tesselatum the interior of these mighty timbers has been eaten away until, in some cases, cavities were left into which a man could creep. A favorite point of attack has been the place of seating of timber upon timber, and the cumulative effect had been that the ridge beam had sagged eighteen inches, and the hammer beams had canted downward at their free ends to the extent of from 10 to 14 inches. The whole roof indeed was in danger of collapse. Repairs were undertaken in May 1914 continued at a slow rate during the war and have now been completed.

For sentimental reasons it was decided to preserve the original roof intact and support the great trusses which are spaced twenty feet apart by means of a specially designed steel reinforcement, superimposed upon and hidden within the timbers in such a way that it would be practically invisible from the floor of the Hall. The nature of the steel truss and its positioning with regard to the timber truss is shown in the insert line drawing and its clever concealment is evident from the two photographic views of the roof as repaired.

This most interesting work of salvage was done under Sir Frank Baines Principal Architect to the Office of Works, to whom we are indebted for our photographs and data. He tells us that Hugh Horland probably found it impossible to obtain oak timbers of sufficient size for the main rafters (about 55 feet long and 16½ by 12 inches in section) or for the main collar beam (two timbers each 40 feet long and 19 by 12 inches in section). The roof was therefore designed in two separate parts, namely, an upper triangulated framed structure, consisting of the main collar beam, two upper principal rafters and two queen posts, and with a central crown post, resting on the main collar beam and supporting the heavy ridge piece. This upper section was supported on two cantilever structures one resting on each wall. Each consisted of the lower principal rafter the horizontal hammer beam carrying at its outer end the vertical hammer post, the vertical wall post resting on a stone corbel in the wall below, and the curved strut between the center of the wall post and the outer end of the hammer beam.

This wonderful old carpenter finally tied the whole roof together by a great curved brace, or arch spanning the whole width of the Hall from corbel to corbel. It was recessed and pinned into the hammer beam and the hammer post, and at its crown it was mortised snugly into the main collar beam. Sir Frank Baines tells us that this type of roof is known as the "Hammer Beam" because of its construction with horizontal beams projecting from the wall head, which support the vertical hammer posts. These posts with the lower principal rafters provide end supports for the upper triangulated structure, of which the great collar beam forms the base. The downward thrust of the hammer posts on the outer ends of the hammer beams is counteracted by the downward thrust of the principal rafters at their inner ends. They are also maintained in the horizontal position by their attachment to the arched ribs and by the curved braces reaching from their outer ends to the wall post.

Whether Hugh Horland intended the great arched ribs to carry the load (or a part of it) of the collar beam and the structure above or no, we think that it actually must have done so. In fact, when the roof decayed and sagged this arch it was that saved the structure. Proof of this is seen in the fact that so great was the load on its footings that in one case a massive stone corbel was sheared entirely through.

The timber was cut between 1393 and 1396. The great size of the main members proves that the virgin forests of England must have contained some giant trees. The wood used was peduncular oak from the Sussex Weald, and as there was no time to season it, the timber was used green and therefore, was extremely heavy. We have estimated the quantities of material in one main truss and its load of one-half of the roofing in each adjoining bay and find that the total combined weight, if we include the lead sheathing of those days is about seventy tons.

As showing the size of the timbers the hammer beams are 21" x 22½" by 17' 9" long, the hammer posts, 38" x 25" by 20' 9" long, the collar beams, two timbers each 19" x 12" by 40' long, the main rafters 17" x 12" by 28' 6" long, and the main purlins, running from main truss to main truss at the level of the collar beam, were built up of four timbers 9" x 12", 13½" x 9", 22" x 9" and 14" x 9"—all 18' 10" long.

We may ask why Horland did not save weight by giving his roof a lower pitch. The answer is that it would have involved a greater horizontal thrust against the walls, and he had no steel tie rods to take care of this. There is not a bit of metal in the whole structure.

The architectural beauty of this great roof is universally admitted. Of the wonderful strength and endurance of the oak, which (in the testing machine) shows that it has in nowise deteriorated, leads Sir Frank to say "It is difficult to say that steel or masonry would have been so perfect after so long a period", and speaking of the way in which the work was executed he says "with the present day knowledge of construction, we must admit, with entire humility, we could find very little fault with the timber construction of this roof and could hardly improve it."

The photograph shows one of the twelve great trusses after the repairs. The insert shows the steel reinforcement and the great dimensions of the oak timbers of the original roof. Each truss, with its load of lead-covered roof as built of heavy unseasoned oak weighed seventy tons

The famous Westminster Hall timber roof

A New Technique of Anesthesia

By Dr. Alfred Gradenwitz

BOTH the medical practitioner and the man in the street generally connect with the idea of narcosis that of nausea and vomiting. In fact, common experience shows that the state of patients on the day following a surgical operation is almost invariably influenced by "post-narcotic" nausea, and endeavors so far made to eliminate these disturbing phenomena have only been partly successful

However, a decidedly new method has just been developed by Drs. C. J. Gauss, of Freiburg, and Hermann Wieland, of Koenigsberg, which not only eliminates these unpleasant consequences of narcosis but even does away with any harmful effects on respiration and blood circulation.

Experiments on animals had shown nitrous oxide only to act on such manifestations of life as are bound up with the presence of oxygen, while leaving those lower organisms which like certain worms, are independent of oxygen entirely unaffected This behavior strikingly differs from that of narcotics proper, such as chloroform and ether, as well as the group of synthetic soporifics, all of which will paralyze the functions of any animal cell—in fact, any kind of living matter Now, inasmuch as nitrous oxide only acts on phenomena connected with the absorption of oxygen, which action is readily compensated for by some slight admixture of oxygen, the narcotic effect of this gas on the brain seemed to be due to a disturbance in the absorption or utilization of oxygen in the nerve cells Nor could it be a case of simple asphyxia, as occurring after the inhalation of nitrogen, hydrogen or the like the symptoms of carbonic acid poisoning (difficulty of breathing and cramps) being practically entirely wanting Again, the two experimenters, having noted that nitrous oxide possesses an exceptional solubility in water rapidly resulting in accumulation in the blood and tissues, were led to think that the presence of some other gas might produce paralyzing effects of a similar nature This was tested by examining the effect of another gas in which water dissolves even more readily than nitrous oxide, viz., acetylene which was found to be mainly identical with the effect of nitrous oxide all processes independent of oxygen being left unaffected while the inhibition induced in higher animals in every detail resembles nitrous oxide narcosis. At the same time there is a remarkable quantitative difference, acetylene, in accordance with its higher solubility, being much more efficient and requiring much lower concentrations than nitrous oxide demands

The use of nitrous oxide as a narcotic has lately been finding increasing favor in surgery, gynecology, etc, though this gas not only is unsuitable for any more extensive operations, but entails considerable risk of asphyxia, while the admixture of air is bound to counteract its effects. Acetylene on the other hand is free from these drawbacks, the presence of oxygen not interfering with its efficiency, so that unconsciousness can be continued much longer, possibly for many hours, without any necessity of applying excessive pressures. This remarkable behavior is due both to the absence of any harmful circulation trouble and to a considerable reduction of combustion processes in the organism. In fact, the originators of the new method are inclined to describe it as a means of producing unconsciousness rather than narcosis proper

Acetylene inhaling apparatus used in connection with the new technique of anesthesia

Pure acetylene (or "narcylene" as it is termed in the present case), free from any impurities, primarily from any poisonous hydrogen phosphide and accordingly devoid of the familiar penetrating smell, was used in these experiments, the slightly bitter taste of the gas being hardly felt on breathing with closed mouth. Narcylene is mixed with oxygen derived from the familiar commercial type of steel cylinder The inhaling apparatus illustrated was constructed by Messrs. Drägerwerk, of Lübeck, and is shortly described in the following

A platform designed to travel on six idlers comprises two fittings for oxygen cylinders, each of ten liters capacity, and one fitting for an acetylene cylinder of 30-40 liters capacity flexible high pressure tubes connecting the cylinder valves with two pressure-reduction valves for oxygen and acetylene respectively, visible to the right and left in the lower part of the figure Between these valves is seen a circular slide for checking the gas mixture in conjunction with the vertical gage and scale visible in the upper part of the figure To the left of this are provided an acetylene washing bottle and a similar bottle for moistening and washing the gas mixture The bag visible in the middle is inflated more or less by the entering gas mixture, its variable volume enabling the experimenter readily to gage the amount the patient requires for breathing A reaction valve, readily lifted during inhalation and which during expiration closes of its own accord prevents the patient s exhaling any used up air into the conduit, this air escaping through a readily movable valve fitted to the mask An apparatus for producing oxygen-ether narcosis is also used as a stand by

Electric contact apparatus for giving local treatments without risk of deranging the bodily functions by passage of the current through the system as a whole

While the new narcotising process is free from the drawbacks outlined in the beginning, the rapidity with which the patient s unconsciousness and any feeling of pain vanish, and normal conditions return after the gas supply has been discontinued are further valuable features both to the practitioner and patient.

Haze and Mist

PERFECTLY pure air is almost completely transparent to visual light waves, and if the air were always pure we should see distant objects through air almost as clearly as through a vacuum But the air is never pure, there are always more or less particles of foreign matter present The action of the particles is twofold first they reduce the amount of light reaching the eye from distant objects, and secondly in the daytime they scatter the general light of the sky and so send to the eye extraneous light which reduces the contrast between distant light and dark objects on which visibility depends. Generally this foreign matter consists of a mixture of solid ponderable particles and hygroscopic molecules The latter in perfectly dry air would be practically invisible but when loaded with water in a humid atmosphere they add to the obscurity of the atmosphere

The amount of obscurity will, therefore vary with the amount of solid matter and with the humidity of the air Haze is due to this kind of obscurity and varies in intensity from the slight obscurity of polar regions, which depends almost entirely on the hygroscopic particles, to the dense obscurity of a dust storm in tropical regions which is due almost entirely to solid particles

When the temperature of air falls, the humidity increases until the saturation point is reached The diameters of the hygroscopic particles grow but even in saturated air the amount of water extracted is not great and if there is little solid matter present the obscurity is not marked But if the temperature falls below the dew point the hygroscopic particles are sufficiently large to form excellent nuclei for condensation and relatively large amounts of water are deposited for small falls of temperature Real condensation has now commenced and the obscurity changes from that of haze to that of mist It has been a common practice to record atmospheric obscurity as haze when there is a noticeable difference between the readings of the wet and dry bulb thermometers and as mist when the readings are the same This however is not a true criterion for the air can be saturated without condensation while mist cannot be formed until water has been condensed on account of a fall of temperature after the dew point has been reached The whole process of the formation of haze and mist is continuous and in practice it is practically impossible to say when haze becomes mist although extreme cases are easily distinguished Nevertheless haze and mist are fundamentally different for haze owes its origin to foreign matter and the small amount of water associated with hygroscopic nuclei while mist is due to an actual precipitation of water from vapor to liquid— *Abstract from article in Nature for April 14, 1923 by G C Simpson F R S*

New Facts About the Curative Powers of Electricity

THE opinion generally held that the curative powers of electricity were first discovered by Siemens in 1844 is one of the many errors hallowed by tradition In fact while the use of electricity for medical purposes had been recommended as far back as about 100 years before Siemens by the Halle physicist Prof Kruger the first undoubted curative success attributable to electricity—viz the healing of a paralyzed arm—was made public by a Swiss physicist Prof Jallabert of Geneva only a few years afterward i e in 1747

This information is derived from a book just published by a contemporary Swiss scientist Mr F K Mueller of Zurich whose investigations have greatly contributed to elucidating the action of electricity on the human body In this book he also draws attention to the fact that the body is itself traversed by a wonderfully complicated system of electric currents which flowing up and down on intricate paths attend the vital functions of the organism so that the application of electric currents from outside if improperly controlled is apt to interfere with these life giving currents and thus to counteract the desired curative effect

This risk is definitely avoided by the new electrotherapeutic method developed by Mr Muller and which briefly summarized could be described as follows Instead of using electrodes having a considerable contact surface edge electrodes are employed which come in contact with the skin along what is practically equivalent to a mere contact line the anode and cathode being separated by a fraction of a millimeter so that the current immediately after entering the skin is caused to leave it without any risk of straying off towards the interior By moving this pair of electrodes up and down the skin any portion desired can be submitted to the treatment and some sort of electrostatic suction is added to the immediate pricking effect of the current thus applied Remarkable results are said to have been obtained in soothing the nerves and allaying pain.

Electrifying Chile's Railways

When Abundant Water Power Takes the Place of Expensive Imported Coal

By Lloyd Jacquet

CHILE is a ribbon of a country, a narrow strip stretched between the Pacific and the high mountains of the Andes. Although the country has a coastline of nearly three thousand miles its average breadth is not more than ninety. It is a land of extreme contrasts, of deserts, of fertile pampas, of snow crowned mountains and burning plains. It has peculiar problems, because of its climatic conditions, geographical location and economical position which no other South American republic possesses.

Perhaps the chief trait of the Chilean is his progressiveness. As far back as 1852, the Capiapo line, a small railroad running between that celebrated copper mine and the little port of Caldera, 55 kilometers distant, was opened to traffic. Actually this may be called the first steam railroad in South America, although some give first place to the Demarara line established in British Guiana.

Chile's transportation problem is a peculiar one. The railroad lines are running through her territorial length north and south. This system is located inland, but a number of transverse lines connect these main lines with the sea. Take, for instance, the central line from Tacna, in the north, running southward to Puerto Montt, at the edge of the Gulf Reloncavi, a distance of 1500 miles. This main line is connected to the Pacific, with branches along the coast at thirty different points.

One of the most important branches, both because the terminal is at Valparaiso, the capital, and because it is the beginning of the Transandean system, is located in about the middle of the long Chilean strip, and in the most fertile portion of the country along the Aconcagua River.

The remarkable part about this branch is that it extends to Santiago far inland, and it is the only line which is electrified. This is a most important experiment in the history of railroading in South America.

Chile is not so fortunate in her coal supply, when it is considered that almost two thirds of the coal consumed is imported, and of this amount the railroads use more than one-third. The fuel problem became acute during the war when operating costs rose to such an extent that the railroads were actually operating at a deficit.

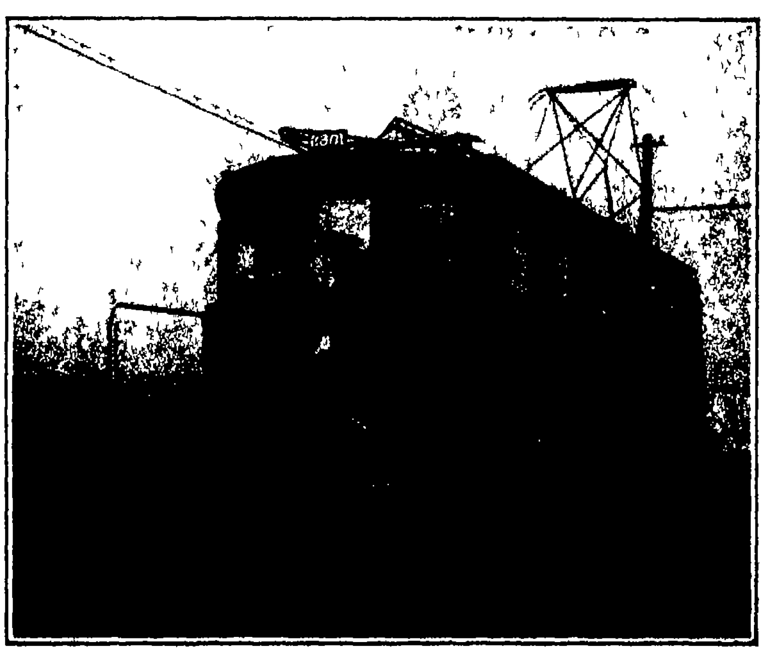
While the country was endeavoring to solve a railroad problem, precious water power was going to waste. The harnessing of this natural resource for power would make the country practically independent as far as fuel was concerned and would permit the electrification of railroads as the best solution to the railroad problem.

Accordingly, a commission was appointed and a careful analysis of electrification systems throughout the world was made. As a result of the study made, principally concerning the economies in maintenance obtainable with the electric locomotives, the possibility for regeneration on descending grades, the elimination of watering and coaling stations, the increased traffic facilities, in general, the electrification of the broad gage line from Valparaiso to Santiago, including the Los Andes branch, was decided upon. The lines now being electrified comprise a total of 233 track miles and include the main divisions connecting Valparaiso, the sea port, with Santiago, the Chilean terminus of the Transandean system, and a branch line to Los Andes. The railroad runs along the coast line of Valparaiso harbor, follows the Aconcagua River after going over a low range of hills to Las Vegas, where the Los Andes branch leaves the main line. At Calera, the Longitudinal Railroad starts northward. Llai Llai, almost midway between Valparaiso and Santiago, is the junction point for all passenger trains for the Los Andes branch. It is at this point that the heavy grade section over the Coast Range Mountains begins and continues as far as Batuco, on the eastern side.

Although there are many curves on the line, these may be said to be of medium severity. The most severe curves are located on the section of the line between Llai Llai and Til Til, with the maximum curve of 10 degrees near Los Loros. However the grade conditions are the greatest problem, and have always been a big obstacle in the rapid moving and expediting of traffic, particularly when steam was used. On some of the

Type of steam locomotive which will be replaced by electric locomotives on the Chilean State Railway

grades such as the Tabon grade of 2¼ per cent, which is a little over 12 miles in length, passenger trains require the service of helpers, but, with the electric drive, helpers will be needed only for heavy freight trains. The next heaviest grade is on the eastern slope and is located near San Ramon. It is 1.81 per cent, and it is therefore evident that the heaviest hauling conditions are imposed on south bound trains—that is, those travelling toward Santiago.



Electric express passenger locomotive for the Chilean State Railway. This locomotive will haul a 300-ton train at over 60 miles per hour

Thirty nine electric locomotives of the Baldwin Westinghouse type are being used on the electrified section. These take the place of about 100 steam locomotives. The electric locomotives which have been supplied are divided as follows:

Six express passenger locomotives, each one of the 2250 h.p. type, weighing 259,800 lb., capable of making over 60 m.p.h. with a 300-ton trailing load, length 58 ft. 5 in.

Fifteen road freight locomotives, each of 1680 h.p. and 230,000 lb., capable of making 35 m.p.h. with a 770-ton trailing load, total length 49 ft. 9½ in.

Eleven local passenger locomotives, each 1500 h.p., weight 80 tons, total length 41 feet, maximum 56 miles per hour.

Seven switching locomotives, each 480 h.p., weight 67 tons, and maximum speed 34 miles per hour.

These locomotives make use of a very ingenious device for electric regeneration, which permits a train coming down a grade to generate electric energy, which is sent back to the line, to be used by other trains in service. In this manner, the electric regeneration not only saves electric energy, but also provides further safety for the trains, because it acts as a continuous and adjustable break when the train is on a descending grade.

Of the total number of locomotives, there are already in Chile 14 freight and 6 express passenger locomotives, which as they arrived were assembled by Chilean workmen under the direction of Westinghouse personnel. All of the switcher and local passenger locomotives have also left the Westinghouse plant at East Pittsburgh and are en route to Chile.

The electric power for working the railroad will be derived from hydroelectric plants. The first generating plant, which contains three 8125 Kva. Westinghouse generators, will have an ultimate capacity of approximately 30,000 kw. It is located near Santiago, and is known as the Maitines station, and transmits the power to that city by twin-circuit 110,000-volt transmission lines supported by steel towers. At Santiago the line is connected to the power system of that city, where a combination of steam and hydroelectric plants produce a total of 120,000 kw. of electrical energy.

The object of the substations, of which there are five, is to transform the three-phase high tension current which comes from the hydroelectric plants into 3000 volt D. C. which is used in the locomotives. The substations are located at Quilicura, Rungue, Llai Llai, San Pedro and Vina del Mar. The first and the last of these receive 12,000-volt current, and the other three, 44,000-volt current. The buildings are entirely of steel and concrete and are especially designed to withstand earthquakes.

They are equipped with overhead cranes and the basement of each building provides ample space for control equipment. In each substation are placed two Westinghouse 2,000 kw. motor generator units. These units are of unusually rugged construction, and will withstand an overload of 200 per cent for five minutes without injury. The sets are protected by flash suppressors developed by the Westinghouse Company, and which have already proven so efficient on the Chicago, Milwaukee & St. Paul Railway electrification in the United States.

For the overhead construction, the simple catenary type with flexible hangers was adopted. The overhead construction has a span of 60 meters and the trolley wires are suspended at a height of about six meters above the rails, except at the tunnels, where the height is materially less.

A record was established for unusual shipments in connection with this order. The first shipment consisted of 34 cars of apparatus, which made up two complete substation units of the five included in the contract. The second shipment was even larger than the first, and consisted of 38 cars laden with three complete substation units. Later, six complete electric locomotives were crated and packed as a single shipment.

Interest in this event is not confined to Chile, however. The United States is also directly concerned, because this electrification project opens the way for many other large undertakings in South America.

Science and Blankets

SPEAKING of strange contraptions, one must visit the textile laboratory of the Bureau of Standards to see the latest styles in testing equipment—curious apparatus that takes the blank out of blankets by providing efficient means of solving scientific riddles which heretofore have perplexed textile factories in this and foreign countries The old drab-colored army blanket has become the object of detailed laboratory tests The devices installed by the government experts facilitate the minute and accurate try-out of all kinds of blanket materials under laboratory conditions The old woolen bed cover with its red fringed border no longer holds any dark secrets which baffle science

Anyone who, on a camping trip during rainy weather, has had occasion to sleep under a rubber blanket has been annoyed in the morning to discover that his clothes were slightly damp This was due to the accumulation of moisture given off by the body, which was unable to escape through the impenetrable rubber This simple little test will convince you that for comfort and satisfaction the average woolen or cotton blanket must be a good conductor of moisture as well as being permeable to air circulation To find out the moisture-conductive properties of the ordinary blanket rapidly and accurately, Uncle Sam's textile specialists at Washington have perfected a novel testing pan equipped with eleven special glass beakers Each beaker contains a carefully weighed amount of water The top of the beaker is covered with a piece of blanket, stretched under constant uniform tension and glued into place

The metal pan is provided with an unusual propeller operated by a small electric motor This device keeps the water in the pan in constant circulation Electrical resistance coils are used to heat the water in the curious container to 98.2 degrees Fahrenheit—normal blood temperature These coils are wrapped around the pan and one of them extends into its interior Eleven different kinds of blanket cloth can be tested simultaneously. Each sample is glued in place over the open end of the beaker which contains a known amount of water Then all the beakers are set in the respective circular holes to accommodate them in the top of the pan At stated periods they are removed and weighed The loss of weight in each case is the measure of the moisture that has dissipated through the cloth and shows the moisture-conductive ability of that particular material

To test out how well air may circulate through the various blankets, a special metal cylinder eight inches in diameter is used Over its open end a piece of the blanket cloth is stretched tightly under the same constant tension—between three and four pounds to the square inch—as that applied in the previous test Then vacuum air under light pressure is fed into the cylinder An ordinary gas meter is used to record the amount of air that enters the cylinder while other registering devices keep tab on the proportion of the air that flows through the blanketed end of the container The temperature of the air is held at about sixty degrees. This test demonstrates the air permeability properties of the blanket.

Another extraordinary blanket test consists in stretching the cloth under uniform tension over the top of a curious metal table so equipped with electric batteries and resistance coils that the ends and bottom of the blanket are maintained at a constant temperature of the same heat degree as that applied to the blanket The arrangement is such that the radiant heat can escape only through the top of the covering A galvanometer is used to record the amount of heat given off at different distances above the surface of the blanket The heat applied to the blanket is the same as the average heat of the human body, thus duplicating the conditions that would occur where the blanket was in actual use as an article of bedding The best blankets show the proper balance in the matters of moisture conductivity, air permeability and heat transmission As the result of the standardization of satisfactory blanket testing methods, it is certain that the future production of American blankets will be minus many of the faults and defects that now sometimes occur

One machine that does the work of ten in making rolled-steel car-wheels

Steel Wheels for Twentieth-Century Railroads

THE beginning of the present century saw the start of a race on the part of the big railroad systems of this country for attaining supremacy in covering given distances in the shortest time. The strain of shorter schedules was soon felt Premature breakdown of equipment resulted Wear took its toll much sooner One way only of maintaining such schedules was open The quality of the equipment and its component parts had to be improved and improved enough to care not only for the added rack induced by speed, but also the greater stresses imposed by increased weight

No part of the running gear was more vitally affected than the wheels themselves The demand was felt for a wheel that would better stand the abuse than steel tired wheels which at that time held sway in wheel-making science Research and experiment established the fact that solid wheels made from hot worked steel were better from a mechanical standpoint and it only remained to be ascertained whether their production could be placed on an economical basis One of the old established steel companies pioneering along these

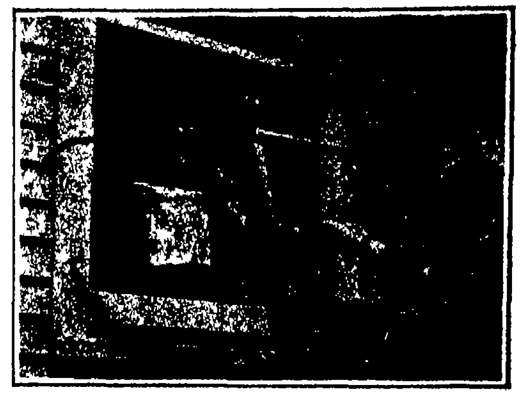
Testing the moisture- and air-permeability of blankets

lines, succeeded in accomplishing this result in the late '90s, and wheels made by hot working the component metal began rapidly to enter railroad practice

This product came to be known as a 'rolled steel wheel,' because of the process first followed in producing it—a process that has persevered until today, although several methods of forging wheels mechanically have since been developed The generic term 'rolled wheels' still holds largely in railroad practice when designating any hot worked steel wheel regardless of the method of manufacture

Rolled steel wheels now serve as truck tender and trailer wheels on over eighty per cent of our locomotives and on nearly the same percentage of passenger cars Their application to freight cars has been much slower because such equipment is not subjected to speed conditions as severe as in the case of passenger rolling stock

The makers of rolled wheels are required to deliver their output to their customers, whether railroads car or locomotive builders completely machined The operations called for include rough turning and finishing the tread and flange of the wheel facing both sides of the hubs and rough boring and finishing ready for mounting on the axle Up to the present this machine work has been handled in nearly all cases on tire mills wheel borers and boring mills, all of heavy fast operating design However, the feeling grew that the industry required a special high production machine designed solely for machining car wheels more expeditiously and by the use of which many machines could be eliminated floor space saved, labor reduced, less power used, extra



A safe place for the paint pot

handling of wheels avoided and the flow of wheels from the rough steel billet to the delivery platform smoothed out and hastened

The officials of one of the largest steel companies concerned, taking the attitude that they could not possibly be as experienced in developing such a machine as a machine tool builder would be decided to make known their needs to some leading manufacturer in that field The nature of the proposed machine, and more particularly what would be expected of it, were outlined The engineers of the machine-tool concern were asked their opinion on the feasibility of such a machine and questions were put to them as to how much time would be required for the design and construction of an experimental machine to determine whether a satisfactory output could be reached

The first machine upheld the promises made and the results sought and is now at work in the plant of the steel company Several more are being installed as rapidly as completed Under regular service conditions, sixty wheels a day are being finished In one hour the machine removes 528 pounds of metal This machine receives the wheels just as they come from the rolling or forging operation The tread and flange are rough-turned and finished and one side of the hub is faced, leaving only the operations of boring and facing the other side of the hub to be performed on another machine

The machine actually handles the same number of wheels on the first operation mentioned that formerly required ten machines so that the total number of machines required to accomplish complete machining on the same output of wheels is reduced 60 per cent

The machine, while styled a 'vertical car wheel lathe' partakes more of the character of a boring mill in that the table rotates in the horizontal plane The frame is an extremely heavy casting shaped like that of a boring mill around the base There, however, the similarity ceases as the frame swings in at the top to give support to the single heavy square vertical bar that carries the hub facing tools. Two side heads which feed inward in a horizontal direction carry the tread-roughing and finishing tools respectively The table is large enough to chuck 42 inch wheels and is driven by a gear with a 12 inch face

Power feeds and traverse are supplied to both side heads and to the facing bar All feeds are independent of each other and automatic trips disengage them at any predetermined point of travel A pneumatically operated crane is built integral with the machine for handling the wheels on to and off the table The machine is driven by a fifty horsepower motor

The Safety Bracket

A NEW invention of great value to painters and tinsmiths is a strong and durable safety bracket The bracket intended for use on ladders is made of ductile steel and may be adjusted to any standard ladder The safety bracket, as shown at the top of the page, holds the ladder away from a building 14 inches, allowing the surface underneath the ladder to be painted without moving it When painting sashes the sash can be raised or lowered at will without raising the ladder Color pots when placed on the bracket are kept clear of the ladder and working surface a safety clip on the bracket preventing pots from sliding against the finished surface

The bracket enables the tinsmith to work easily on the inside of the gutter and take the gutter down or put it in place without reaching and without moving his ladder The bracket may rest against the shingles, holding the ladder away from the gutter and enabling the tinsmith to work without fear of falling or having the wind blow his ladder over as has often been the case where the ladder rested against the metal gutter,

Last Words of Science

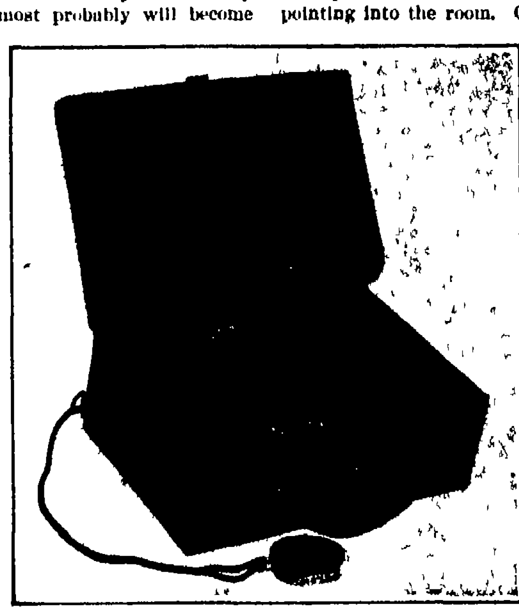
Ingenious Devices at the Recent Meeting of the British Association for the Advancement of Science

By John B C. Kershaw

THE Meeting of the British Association for the Advancement of Science which was held in Liverpool, England, from September 12th to 19th, was marked by one of the largest attendances (3,800) which has been registered in recent years and by several new features that most probably will become permanent additions to the attractions of this annual gathering of scientists

The two most notable of these were (1) the Exhibition of Scientific Instruments and Apparatus in the Central Technical School, which was kept open to the public for ten days, and (2) the Scientific Soirée of the university upon the last evening of the meeting (Tuesday, September 18th), when no fewer than 135 exhibits and 21 short illustrated lectures and demonstrations were planned for the instruction and entertainment of the visitors Both of these new features were an unqualified success, and an attendance of 3500 was attracted to the university buildings on the night of the Soirée

On the Monday afternoon many honorary degrees were conferred in the Arts Theater of the university, and among those upon whom the honor was conferred was Prof G N Lewis, professor of chemistry in the University of California



Highly efficient instrument for assisting those with defective hearing, known as the Otophone

Abstracts of the presidential address, which dealt with the electrical structure of matter and proved the atom to be a minute model of the solar system with a minute nucleus of positive electricity in place of the sun, and negatively charged electrons in place of the planets, have already appeared in American technical journals. This article, therefore will deal solely with the novelties shown at the Exhibition of Scientific Instruments referred to above, many of these being quite new to the general public

The Frenophone is a friction-operated loud speaking telephone apparatus, in which amplification combined with great purity of reproduction is achieved by utilizing the friction that occurs between surfaces of glass and cork The instrument consists of an ordinary reed type telephone earpiece receiver in which a steel pin is soldered into the reed a cork faced steel pad on which the pin presses, a glass turntable driven by a clockwork motor, and a diaphragm at the base of a loud speaker trumpet.

The output from a Burndept wireless receiver is supplied to the telephone earpiece, in the usual manner Speech vibrations set up in the reed travel along the pin and are imparted to the cork faced disc The vibratory changes of pressure on the cork cause variations of the friction between the pad and the surface of the revolving glass turntable on which it lies It is usual to treat the surface of the glass with a special preparation In order to increase this frictional grip As the friction varies with the speech vibrations the pad is pulled more or less in the direction of rotation of the glass and, by linking it to the center of a loud speaker diaphragm the frictional pull produces speech in the trumpet very greatly magnified

The Photophone as its name implies, conveys sound by means of light and is the invention of Mr A O Rankine Mr Rankine produced it during the War for the Admiralty and its usefulness to the Navy is obvious Verbal messages can be sent by this device from ship to ship with absolute secrecy for an enemy attempting to tap the message would be obliged to take up a position between sender and receiver and would thus be visible to both

In the instrument shown, the transmitter, or light modulator was in St George's Hall whence the fluctuating light, concentrated into a narrow beam, proceeded to the receiver in Room 29 at the Central Technical School, where the transmitted speech was heard. The photo-electric cells used were selenium cells, made according to the design of Prof. H Thorring of Vienna.

For demonstration purposes the speaker sat at a window of St George's Hall, talking at a mirror A V shaped board rested on the window ledge, the apex pointing into the room. On one extremity stood a 500-candle-power electric globe, and opposite this was a large condensing lens, covered with a metal grid. Another similar lens stood by its side on the opposite arm of the board, and in front of them at the apex was a phonograph diaphragm to which was attached a tiny mirror This mirror received the light through the first condensing lens, and was so adjusted as to reflect the image of its grid upon the grid of the second lens. When the sender spoke into a trumpet to the diaphragm, the vibrations caused the little mirror also to vibrate, and this in turn caused the image of the first grid to vibrate on the second grid. In other words the amount of light passed through the second filter fluctuated as the voice vibrated the mirror

At the Technical Schools, 100 yards distant, quite a different apparatus was set up This consisted of a kind of camera, with a huge lens facing the all important window at St. George's Hall The lens collected the vibrating rays of light sent out, and focused them on a plate of photo-electric cells (selenium), and thereafter the vibrations were translated back into the spoken words Sunlight may be employed for this purpose, and the effectiveness of the Photophone is limited by one factor only, the fact that light travels in a straight line The curvature of the earth, for example, would quite preclude the possibility of sending a light message below the horizon

The Optophone is the invention of Dr E E Fournier d Albe of London and has been modified and developed by Messrs. Barr & Stroud Ltd of Glasgow Its purpose is to enable the blind to read ordinary printed matter, such as books or newspapers This is accomplished by producing, in a telephone receiver a series of musical notes which take their sound character from the shape of the letters, as they are passed over by the instrument in traversing a line of printing Its construction and operation were described in these columns several years ago Suffice it to say here that the instrument depends again for its action upon a remarkable property of the chemical element selenium the electrical conductivity of which in its grey crystalline form, varies greatly in accordance with the amount of light to which it is exposed In the Optophone, a selenium bridge is exposed to successions of sets of light pulsations, which vary according to the forms of the letters which are passed over in traversing a line of printed type, each letter being indicated in the telephone by a characteristic motif, comprising successions of single notes and chords. Printed letters are thus translated into a sound alphabet, which can be readily learned

Friction-operated loud-speaking telephone utilizing friction between glass and cork, known as the Frenophone

The printed page to be read, is placed face downwards on a glass plate, supported on a suitable stand. Beneath the plate is a tablet of porcelain, pierced with an aperture to permit the passage of light upwards, and so through the glass on to the paper The upper surface of the tablet around the aperture, is prepared as a sensitive selenium bridge, and is connected up to a battery and a telephone. The selenium bridge receives only light reflected from the page. The light used is obtained from a small straight filament electric lamp, placed beneath a rotating disc perforated with small holes arranged in five concentric circles near its edge. The disc is kept in rapid rotation by motor

Above the disc there is an optical system, which throws on to the paper an image of the lamp filament as it would be seen through the perforations in the disc By this means the light that falls on the printed matter forms five bright spots in line, forming what is called the "scala" Each spot is pulsating at a rate corresponding to the number of holes in the circle of perforations to which it belongs, multiplied by the number of revolutions per second of the disc There are 18 holes in the innermost circle, 24, 27, 30 and 36 in the other circles respectively, and if the disc makes 21⅓ revolutions per second, the second circle of holes will produce 512 pulsations of light per second, corresponding to the vibrations in the musical note C The numbers of holes given above are in proportion to the vibrations in the notes G, C, D, E, G

The spot of light corresponding to low G is caused to fall on the lowest points of such letters as j, p, y, etc, the high G falling on the tops of capitals and of the high letters. The three intermediate spots cover the height of the short letters.

Then there was the Otophone. This is the most efficient instrument yet produced for assisting those with defective hearing It is the result of several years' careful investigation by the Marconi Research Department, and it embodies the latest developments in sound transmission and reception. By aid of this instrument, those who would otherwise hear nothing can clearly understand all that is said within many feet of the instrument, and can enter fully into the enjoyment of a lecture or entertainment. The Otophone also relieves a deaf person of that feeling of deficiency which usually accompanies deafness, and enables him or her to take part in a dinner table or drawing-room conversation, with ease and comfort.

Study of Quenching Mediums

THE object of a new investigation started by the Bureau of Standards is to obtain more complete information than is now available on the cooling properties of the ordinary quenching liquids used in the heat treatment of steel. It is also hoped that some information bearing on the subject of dimensional changes, occurring during the hardening of steel, will be obtained. The preliminary work has been devoted largely to setting up the necessary apparatus, but a few preliminary experiments have been carried out on quenching nickel cylinders in water with very satisfactory results, and as this work is now practically completed, it is hoped that rapid progress will be made on the main investigation

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Still another tractor that walks—on its front legs, that is to say

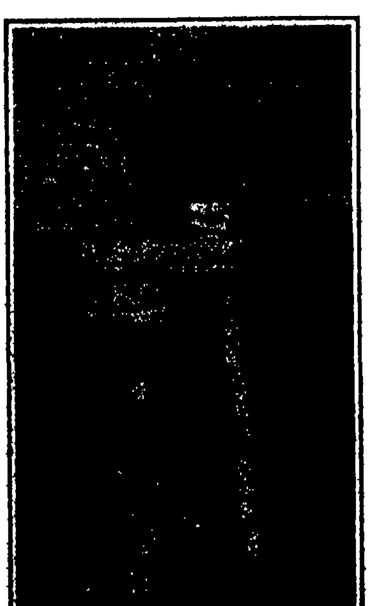
The Walking Tractor

IN this day of scientific progress it looks as if we were going back to first principles or to imitate nature in many things. And the latest case to illustrate this is an invention of Fritz A. Nilsson, a mechanical engineer of Stockholm, Sweden. Mr. Nilsson has perfected a tractor which has been tried and tested by the Agricultural Department of the Swedish Government. It is called the Itus motor tractor, and it moves forward hauling a load without the use of driving wheels or caterpillar chains. In other words, the "Itus" is a walking tractor using intermittently moving levers or "legs," which retain a fixed grip in the ground.

The power from the motor is transmitted through planetary gear and segments, which produce a movement of these levers almost identical to that of a horse, when the animal is pulling a load. By thus imitating nature it is found that the weight of the tractor may be limited to the necessary weight of the motor and component parts of the apparatus, because the resistance of load against forward movements of this tractor will in an equal degree increase the grip of the lever-legs in the ground and it is only necessary to provide shoes suited to the nature of the road or field on which the machine is to proceed.

The general design of the Itus motor tractor when built for heavy services consists of a platform on which the motor is carried. The front end of the platform is mounted on a pair of light guide wheels. On the back of the platform two sets of planet gear boxes are mounted each with a pair of levers extending underneath the platform as legs. The planet gear boxes are connected to the motor by differential gears in such a way that one pair of lever legs can move forward more swiftly than the other which will allow the "Itus" to travel in any desired curve with facility. The movement of the lever legs is timed so that two legs are always planted on the ground before a leg is raised. As soon as the leg is lifted from the ground, the movement is uniformly accelerated, until the midway point of the curve is reached where the speed is five times greater and then gradually decreases, until the leg reaches the ground again, where the speed is the same as at the beginning of the step. This movement is effected without cams, springs or chains by an ingenious direct gear-drive.

When a small tractor, such as is used on a small farm, or garden, is wanted the inventor has designed such a one but this is equipped with only one planet gear box and one pair of lever legs. This type is adapted for pulling one plow and the driver walks behind it.



Water-motor attachment for beating and whipping

An Inexpensive Kitchen Servant

THE other day we saw a water motor advertised in the newspaper and having had sad experience with similar devices we bought one and tried it out in our domestic laboratory—the kitchen. This water motor is intended to lighten the tiresome process of beating and is entirely successful. It consists of metal casing adapted to be screwed to any standard threaded faucet as one would a garden hose. The water under pressure enters the casing, actuates the miniature turbine, and escapes by a spillway pipe at the side. In some cases, particularly in apartment houses, there is no thread on the faucet as there is no lawn to water. To make the motor usable in this instance, an adapter containing a rubber washer is provided. This adapter is secured to the faucet by three set screws and our engraving was made in our photographic laboratory using the adapter. It worked beautifully, but not so when we tested it further at home. The bottom of the tap was not entirely round as was determined by a soap impression of the orifice, so another plan was adopted to prevent a leakage of the water and consequent reduction of pressure.

A second adapter was therefore bought for 50 cents and made the tap in reality a screw tap. This consisted of a small length of rubber hose secured to a threaded collar adapted to receive the rotating sleeve on the motor-casing. The rubber is shoved on the tap and is tightened by a band secured with a thumb-screw. In practice it was found quicker to apply this rubber on the faucet each time rather than to unscrew the motor. Any fruit jar of the so-called "Mason" variety will answer and we only have to screw the jar to the motor and push the rubber on the faucet, give one turn to the thumb screw and start the water flowing. The beating arms rotate at high speed and beat cream, eggs, pancake batter, mayonnaise, custard, malted milk, frosting, or sauces. If the jar is not needed as in cake batter, a bowl answers perfectly well. If the Mason jar is broken another can be secured from the five and ten. A motor of this kind saves a great deal of drudgery and costs nothing unless you have a water meter and is even worth while in that case.

A Means for Increasing the Efficiency of Steam Radiators

FOR esthetic reasons, and also because it has become a custom, the radiators employed in heating buildings are usually painted with aluminum or bronze paint. From the viewpoint of obtaining the maximum amount of heat from a radiator of a given size this is one of the most inefficient paints that can be applied. Tests in progress at the Bureau of Standards on the emissivity of sheet iron covered with white paint, enamel and aluminum paint show that the aluminum paint emits only 27 to 30 per cent as much as a nonmetallic paint or enamel.

It has been generally known for some time that aluminum paint is not so good a radiator as a nonmetallic paint. Some published data indicating that the emissivity of aluminum paint was about 75 per cent that of a nonmetallic paint, such as iron oxide. With increase in age and other deterioration the surfaces used in the present test would increase in emissivity but it is evident that for efficient service we should educate ourselves so as to become accustomed to the use of nonmetallic paints such as the oxides of iron, chromium, white paint, etc., for metal radiators.

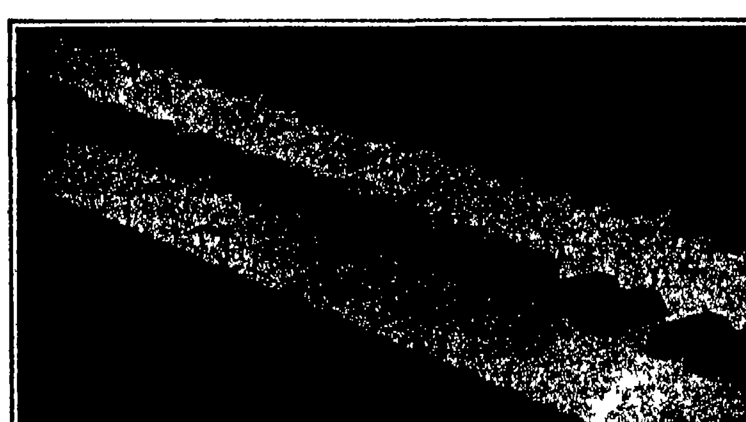
Ordinary rocker converted into a temporary wheel chair

A Wheel Chair from Any Rocker

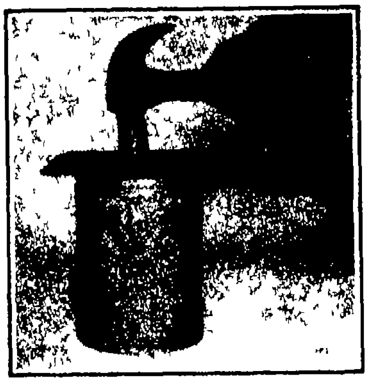
FEW homes are free from invalids. The unexpected accident frequently makes it necessary for a wheel chair to be brought into the house. This invention has been brought out by an experienced nurse of Indianapolis, Indiana, to take the place of a cumbersome wheel chair when necessity demands. It makes any rocker a wheel chair in a very few minutes. Is attached by felt protected clamps to the rockers. The foot board is adjustable to suit the comfort of the user and in every respect the invention provides a satisfactory invalid chair.

Is the Piano Keyboard Obsolete?

THERE are some things which have become so well established that it never occurs to the least conservative of us to study out a way to improve them. One of these is the keyboard of the piano. But Dr. Moritz Stoehr, the recent inventor of the device for transposing and recording music called the music typewriter, is not a conservative musician. Now he has come forward with another invention—an improved style of keyboard for the piano. Tests that have been made on this piano have shown that a musician can very readily adapt himself to the change. In one test a pianist of unusual ability sat down before the new piano without ever having seen one and played several intricate selections



Doubling up the piano keyboard to halve its length



Fruit-jar sealing without paraffin or rubber rings

with the same facility as on the regular keyboard

The new Mehlin keyboard is double. The inventor whom we have already named, could see no reason why the keys of a piano need be so long. Observation of many musicians while playing the piano showed him that a few struck the keys near the fallboard, but most used only a small part of the key at the front. Hence, the result we see in the photograph. Diligent practice has had to make up for the fundamental defects in the regular keyboard while the new reduction in size of the keys does not bring the fingers any closer together than in the case of stringed instruments. Dr. Stoehr, who lives in New York City, states that a keyboard of 10 by 5½ inches affords ample room for the player's fingers. Another advantage of this is that it affords two pianos in the space of one.

To Deal with Cling-stone Peaches

THE accompanying drawing shows an electrically driven pitting saw for cutting and removing stones from cling peaches. The device consists of a rapidly revolving saw in front of which are two knives A and B. By means of the nuts shown at C C, the upper knife is adjustable enabling it to be used on large or small peaches. The peaches are slipped on to these knives and moved forward toward the revolving saw. As the peaches are forced along between the two knives the fruit is cut almost into the stone. The operator keeps feeding the peaches in between the two knives which forces the forward peaches into the revolving saw, which cuts the stone completely in two, the two halves dropping out into proper receptacles. By means of the device shown in the man's hand at the right the stones are then quickly removed from the peach halves. The device consists of a piece of steel with saw teeth as shown at G. This piece of steel is given a vibratory motion by means of an electric motor driving a flexible rod H. The operator picks up a half of a peach with the left hand and removes the stone by using the steel with saw teeth like a spoon, passing the piece of steel around the half of the stone, the vibratory motion cutting the stone from the peach.

The envelope sealing machine that is indifferent to the envelope's size or thickness

A Friction Seal for Fruit Jars

THE procedure of sealing fruit jars with paraffin or with rubber rings is familiar to every housewife and doubtless few of them have suspected that there might be an easier or simpler way of preventing the entrance of air to the contents of the jar. We illustrate an outfit for which just this greater simplicity and ease is claimed—not to say a word about greater economy. When the tin cover is forced down tight in some such way as illustrated the double friction surfaces adjust themselves to one another in such a manner that leakage in either direction is impossible. To open, a screwdriver or similar instrument is used and with ordinary care, it is stated that the same cover may be used repeatedly.

Telephone Silencer for Navy Use

A DEVICE known as the hush-a-phone which has been successfully used in business offices has recently been found of interest to officers of various Navy Departments, particularly of the United States and Great Britain.

One advantage sought is to enable control officers located in close proximity to be able to transmit firing data without disturbing each other. The effect being to talk as if in a quiet room instead of each contributing to the clamor of phone talk.

Another advantage gained, is that surrounding noises of machinery or gun fire is kept out of the transmitter producing a more "quiet wire."

The improved hearing resulting from a quiet wire increases the certitude of accuracy in transmitting firing data being analagous to the commercial application where accuracy in transmitting orders for the buying or selling of stocks and bonds, quotations, train despatching and orders for merchandise, is secured by use of the hush-a-phone. Errors in this work are costly and their elimination productive of efficiency and economy.

One Machine to Lick All Envelopes

THE necessity for automatic sealing of envelopes is felt in every large office, but it has not always been found possible to get a single machine which without tedious adjustment would take all the sizes of envelope which a given office sends out. A new apparatus will seal an envelope of any over all size and of any thickness, without adjustment. Its operating speed is 40 per minute. Proper tension between roller and moistening roll is secured by means of an adjustable bracket, the envelope to be sealed being drawn between the two. The sealed envelopes are stacked under a metal plate which is heavy enough to give the pressure needed to make the seal effective.

Pen and Pencil in One

HERETOFORE we have been in the habit of carrying a fountain pen and in addition a mechanical pencil. Now ingenuity has developed a combination fountain pen and mechanical pencil. What we carried as two articles we can now put in the pocket as one. There will be some pocket unloading when the new device becomes generally known.

Thermal Opalescence in Crystals

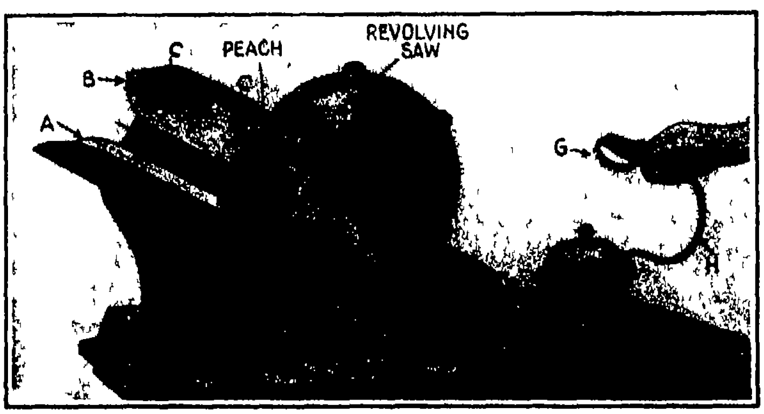
IN a recent issue of *Nature* Mr. C. V. Raman of Calcutta, describes experiments to determine the thermal opalescence in crystals and the color of ice in glaciers. If a block of clear ice free from air-bubbles striae, or other obvious inclusions, and having flat sides, be held squarely and a narrow pencil of sun light concentrated by a lens be passed through it the track of the pencil shows a beautiful blue opalescence. It is advisable not to use a very highly-condensed cone of rays, as this would cause internal melting of the ice with formation of cavities which reflect white light and distract the eye. A dark background should be provided against which the track may be viewed. With small or irregular lumps of ice, the observation may easily be made by immersing the ice in clear distilled water contained in a glass flask which is painted black outside windows being provided for ingress and egress of light and for observation of the opalescent track. Even with ice which at first looks unpromising owing to internal flaws or inclusions, portions in which the blue opalescence is not overpowered by disturbing effects may be picked out. A suitable orientation of the block with reference to the direction of the incident rays is often useful in avoiding reflections from cavities in the ice.

The atomic scattering of light in block-ice demonstrated and measured in these experiments should certainly be capable of being observed on a large scale under suitable natural conditions. Indeed, it is well known that masses of ice in glaciers and icebergs often exhibit a blue color, and it appears to the writer very significant that the circumstances in which natural ice shows a blue color are precisely those found to be necessary in the laboratory in order that the blue opalescence due to internal scattering may be satisfactorily observed, that is, that the ice should be of the maximum clearness and transparency in either case air-bubbles striae and other inclusions obscure the effect sought for. The inference that the phenomena arise in the same way seems legitimate. A different explanation of the color of natural ice has been put forward by Tyndall and other writers, that is, that the color is simply an absorption effect. However, it appears that the latter view presents fundamental difficulties. *Prima facie*, no substance can exhibit color in its own body except as the result of internal diffusion or scattering. Color due to simple absorption can only be perceived when a luminous object is viewed through the substance, and even then it is the source, not the absorbing medium, that appears colored.

The absorption theory thus leaves it unexplained why clear ice should exhibit any color at all. Indeed, it would appear that the color of ice is often very conspicuously observed when the light traversing it has no chance of reaching the observer's eye directly. Thus for example, in his lecture on ice and glaciers Helmholtz describes very vividly the experience of the Alpine traveler who, traversing the broken surface of the glacier along a narrow ridge, looks down into the crevasses on either side and observes their dark blue walls going down to the depths. It is obvious that in such a case as this, the light filtering down into the solid mass of transparent ice forming the glacier through the superficial layers or otherwise, has no possibility of returning to the observer above save through internal scattering.

The natural view to take is, therefore, that the blue opalescence is the real cause of the color of transparent ice observed under such conditions, the absorption of light in traversing the medium tending merely to diminish its intensity and make it of a more saturated hue.

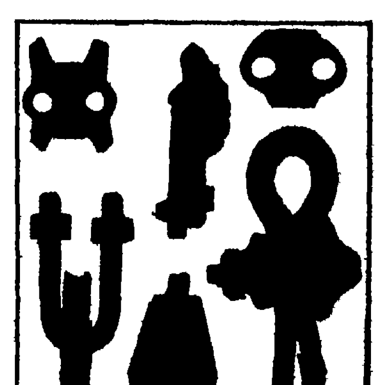
A single writing tool that plays the part of fountain pen and pencil



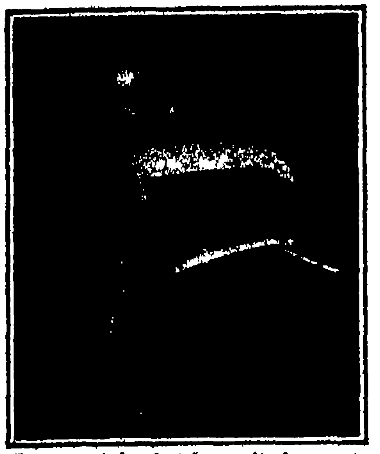
When the peach and the stone refuse to part company, this little machine demonstrates that indirection may sometimes be the shortest way around. It cuts the stone in half, and then frees the peach separately from each half

Safety Clamp for Wire Rope

FOR fastening wire rope a clamp with a U bolt and self tightening cam which cannot slip or crush the cable is now being manufactured. The clamp is applied square with the cable and tightened with a wrench. A feature of the device is the use of a grooved cam which serves the double purpose of protecting the cable from the concentrated pressure of the U bolt and of providing an eccentric movement which causes it to increase its grip as the cable turns it under pressure. Only one clamp is required for each cable. The self tightening feature automatically compensates for the shrinkage of the cable under load, and merely grips the tighter as the load increases.



Novel clamp that grips wire rope in a slip-less grip



The spotlight that keeps its beam at the side of the car

The Safety Spotlight

THE elongated lower lamp in this new spotlight floods the side of a car and the road over which it passes with a flood of light. This makes less dangerous the passing of another car on a dark country road.

Each light can be operated independently from a switch on the dash. With such a light there is protection for the driver of a car as well as the man approaching.

A Machine to Meet the Rabbit Plague

ONE WAY to deal with rabbits, the great Australian plague, is to dig up their burrows. This, however, is largely a loss of effort, for the rabbits reopen the burrows as fast as the workers can destroy them—if not faster. Mr. E. K. Bowman, of Wargundy, has invented an interesting apparatus that attacks the problem from the other side. He fills up the holes instead of digging them out, and he does this by machine. Roughly speaking, what he has is a tractor that carries two tanks, one of earth and one of water. The earth is kept replenished by a digging element attached to the machine. The earth from the one tank and the water from the other are mixed by a revolving concrete mixer and passed down a chute, from which the mixture is directed into the burrows. After drying, this mixture sets like cement, and the animals make no effort to reopen the burrow.

An Angle Machine for Unusual Jobs

A LITTLE machine that can do a great deal of heavy work of an unusual nature is an angle and bar bending machine which has just been perfected. The machine is equipped with dies and gages which eliminate the necessity of laying off stock and make the production of duplicate angles and bends easy. It performs an unusual variety of work.

The new angle bender, and some of its work

The bender will bend angles of any degree, round and flat stock, will bend angle iron after cutting V in wing of stock at bending point, will bend flat stock edgewise, and with U blocks will bend perfect U's and hooks. It has the following capacity: Bends flat stock hot up to 2 by ½ inches, rounds and squares up to ⅞ inches; bends flat stock cold up to 1½ by ¼ inches, rounds and squares up to ½ inch; bends flat stock hot 1¼ by ⅜ inches and under edgewise; bends angle iron up to 2 by 2 by ¼ inches by cutting V in wing at bending point.

Proper Steel for Automobile Bumpers

THE bumper of an automobile has not been ordinarily regarded as a portion of the car which should need incorporated in it any special grade of steel or any particular scientific attention. In many cases a properly bent strip of cold rolled steel or even a piece of steel pipe has been used.

Considerable attention has been devoted to this part of the car recently. It has been found that, unless the bumper is of the proper material and properly heat treated, harm to the car is likely to result. For example, if the bumper is too rigid, a collision may break the frame of the car and if it is too frail in resistance to a blow or impact much damage may follow.

Recognizing these facts automobile insurance companies are now specifying a bumper of steel or special material worked or heat treated so that the steel will meet certain specifications—made of a material which will pass certain impact or shock tests, closely approximating general or standard service conditions.

The Uses of Radium

IT was early discovered that radium broke down successively into emanation, radium a, radium b, radium c and radium d, gaining equilibrium with these decay products in approximately thirty days. During this process of disintegration three rays are given off—alpha, beta and gamma. The first has little penetrating power and is stopped by a sheet of paper. The second is more penetrating while some of the third will penetrate ten inches of steel. Shortly after the discovery of radium it was found that the last two rays were destructive to certain kinds of cells and the medical use of radium in the treatment of various conditions is built around this susceptibility of the cell to the action of radium rays.

Many different conditions are treated by radium, including cancers and tumors, although radium is also used in much less serious conditions, for example the removal of birthmarks, warts and tonsils.

At present extensive work is being done on cancer. Except in very advanced cases, this disease can be arrested, but the big problem is to prevent its recurrence. In case it does not recur in ten years, it can be considered to have been cured. Ten years, however, is a very long time for experimental purposes, and interesting experiments are now being carried on with mice and flies. If the disease does not occur in ten weeks in the case of mice it has been eradicated, while in the case of flies, the time can be measured in days. Hence these experiments will shortly give knowledge which would require an exceedingly long time to acquire by the treatment of human beings.

Two general methods are being followed today in the use of radium in medicine. The first is the use of radium sulfate put up in needles, tubes and plaques. The needles most widely used are the 10 milligram non-corrosive steel needle having a diameter of 1.5 millimeters and a length of 29 millimeters (about the width of a pin head and a trifle longer than the ordinary pin) and the 5 milligram needle having the same diameter with half the length. The barrel of these needles is bored out to provide a radium chamber into which the radium is inserted. Asbestos packing is then placed next to the radium, the eye is inserted and then soldered into place.

In the treatment of disease these needles are buried directly in the affected tissue and left until the required radiation has been delivered.

A second method is the use of radium emanation which is the first disintegration product of radium and a gas. This necessitates the use of a solution of some radium salt, preferably the bromide, which is unstable. The radium solution is usually placed in a closed container in a safe with a tube leading to a pumping and connecting apparatus, the gas being pumped off and collected in fine glass capillary tubes. These are sealed off by flame and imbedded in the tissue-like needles except that needles are extracted while the glass spicules are left in. The radioactivity in these spicules loses 16.5 per cent the first day, 16 per cent of the balance the second day, and so on, becoming entirely inactive in thirty days.

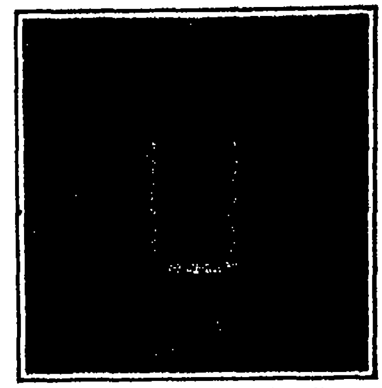
Two views of the Australian machine for filling rabbit burrows

Shoes Shined for One Cent

MOST of us are familiar with the various "Penny-in-the-Slot" machines. We can now add to the number a machine which makes it unnecessary it is claimed to spend five or ten cents a day for a shoe shine which is not really needed except that the shoes need a dusting and the wearer has scruples against using his handkerchief for the purpose, besides exerting what to some persons is too great a physical effort.

All one need do now is to drop a penny in an automatic shoe-brushing machine, place the foot beneath the rapidly revolving brush and in half a minute the shoes are cleaned from mud and dust and the original lustre of the dressed leather is restored. The brush which revolves an ample length of time to thoroughly cleanse each shoe is a specially made affair of the same type used at shoe factories in putting the final finish on shoes before shipment.

This machine will not shine a shoe that has nothing on it with which to work, but it will, however, keep Sunday's shine bright and clean for a surprising length of time, if used regularly.



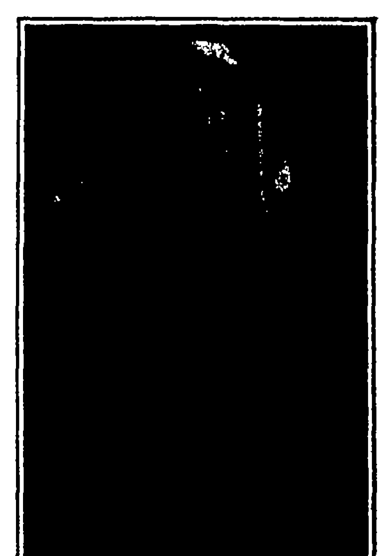
The illuminated keyhole for illuminated people

The Self-Finding Keyhole

THE Amalgamated Association of Joke-smiths of America has not yet given official consideration to the question whether prohibition applies to its members, and until it does so jokes which depend for their point upon the assumption that the hero—or the goat, in the more usual case—was slightly jangled are still within the law. In the present instance we shall let each reader supply his own humor to go with the accompanying picture. The photograph in question depicts a recent German invention—the luminous keyhole. A rectangular frame around the hole, covered with radium paint, lends precision to the efforts of Heinrich Beerguzzler to bring about a connection between key and lock and thus to get into his residence in the wee small hours without arousing the neighborhood. Theoretically the device is outlawed in America, but from the recent utterances of the Governor of at least one of our states, we judge that it might find considerable local applicability.

Rail Car Used in Building Dam

THE Georgia Railway & Power Company has one of the most complete and comprehensive plans for hydroelectric power development in the country. The first development was at the Tallulah Falls in 1913, then came the Mathis Reservoir and the Burton Dam. The Tugalo Development Dam is about 400 feet below the point where the Chattooga and Tallulah Rivers unite to form the Tugalo. Two more developments are planned to come later. In order to build such an enormous dam and power house, approximately 1000 men moved to this site, forming quite a village with their



Saving yesterday's shine with a penny in the slot machine

The trouble shovel that is easily carried in the car

families This site is about twelve miles from the main line of the Southern Railway and a standard gage railway goes from the main line to the dam At the junction point a station has been erected and named Tugalo This is about six miles north of Toccoa

The Georgia Railway & Power Company proved its progressiveness again by putting into service a rail motor car on this stretch of track between Tugalo station and the dam This truck is a 3½ ton of standard make equipped with a cab and a stake and rack body The front of the truck is mounted on a four wheel pivotal pony truck The rear wheels are regular wooden truck wheels fitted with steel locomotive tires The steering gear of the truck is connected to the hand brake rigging which acts on the front wheels Thus the foot brake functions on the rear wheels while the steering wheel applies the special brake on the front pony trucks The truck hauls regular freight cars and flats equipped with seats to carry passengers plus freight The track works its way through a very beautiful section of the country and the truck travels fully fourteen miles before reaching the dam site

No More Juiceless Pies

THE old fashioned housekeeper will recognize in the attached picture the modern version of an ancient device—the pie-crimping wheel Mrs Newlywed on the other hand, may have to be told that the purpose of the little wheel on the end of the handle is to seal the two crusts of the pie together so that the juice remains where it belongs—inside the pie The pronged wheel, as it is run around the edge of the pie, trims off at the same time all superfluous dough The result is a pie that doesn t stick to the pie-plate, but does stick to the ribs of the happy consumer

The latest pie-crimping wheel

A Spade for the Mired Car

FOR getting the stranded car out of the sand and mud a shovel is sometimes the finest little tool imaginable But carrying in the automobile a shovel that is more than a toy, presents its difficulties One solution is illustrated herewith This shovel is very far, indeed, from a toy It is a regular spade, substantially made The trick is that the size and the length of the handle are such as to enable it to be carried beneath the car seat without folding the handle With an unbroken handle much greater strength and greater digging efficiency are obtained And, wrapped in its shipping bag and stowed beneath the seat it travels without any rattle.

Three Guns for the Price of One

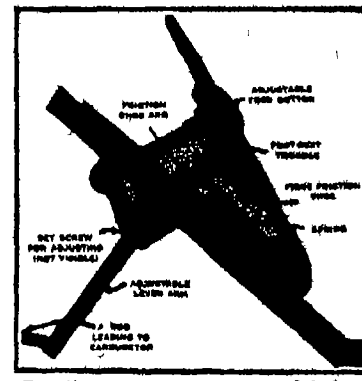
THE average sportsman returns with a gun weighing apparently ten times as much as it did at the start of the hunt It is rather fortunate for him that there has been placed on the market a combination arm that can be dismantled in about one minute and distributed about his body thereby lessening the dead weight of a complete gun

This welcome weapon is a combination repeating rifle target and small game pistol, and pocket pistol The change from an accurate well balanced pistol into a long range rifle is made by simply removing the 7½ inch pistol barrel and screwing into its place the 20-inch rifle barrel to which the forearm is already fixed A butt stock is then attached by means of a single screw or bolt and the rifle is complete for effective work it is claimed at 450 yards range. The weapon is as easily changed into a pocket pistol by substituting a three-inch barrel The slide on the receiver is fitted with a folding pistol and rifle sight With the leaf laid down it is an open pistol sight of the navy type and for use with the rifle the leaf is raised and the arm is then equipped with a peep sight adjustable for range by means of a slide The bolt lock is easily depressed by the thumb of the operator and drawing the bolt to the rear extracts and ejects the empty shell By moving the bolt forward a cartridge is fed from the clip into the chamber and in the same movement of the bolt the arm is cocked and ready for the next shot It is said that there is one important feature which is particularly valuable when this weapon is used at the target range The breech can be left open until the very moment of firing as it has a safety catch which, when it is raised makes it impossible to discharge the arm or move the bolt, as the trigger is entirely disengaged The manufacturers also claim that this arm has all the desirable features of a single shot weapon without the loss of power through the escape of gas true of revolvers and automatics.

The three in-one firearm, assembled for use as pocket pistol, rifle and target-and-game pistol

The Shock-Proof Accelerator Pedal

THE difficulty of keeping one's foot steadily on the gas on a rough road is claimed to be overcome in the accelerator of new design which we illustrate in the accompanying drawing To feed the gas, the feed button is touched with a light pressure of the gas, and depressed until the desired speed has been gained Then the foot is allowed to rest in a natural position on the foot treadle. Without exerting any pressure whatever, the weight of the foot alone on this treadle is sufficient to cause friction between the lower surface of the treadle and the friction shoe, and thus to hold the gas in the same position The gas flow is retarded by allowing the foot to come back, as with the ordinary accelerator The new pedal is applied in sizes suitable for all cars.



Details of the accelerator pedal that gives a rest for the foot

The Haber Process of Ammonia Synthesis

THE early experiments of Haber, like most of those which have served as the foundations of great industrial undertakings, were made with a purely scientific object, and with no technical applications in view The results obtained, however soon made it clear that the basis of an important technical process could be found in ammonia synthesis, and further work was undertaken with this end in sight

In 1908 the Badische Gesellschaft placed at Haber s disposal all the means requisite for the further progress of the research on the synthesis of nitric oxide in the electric arc which he had begun in 1907, but his proposal to undertake research on the synthesis of ammonia was received with open doubts as to the potential value of the method The nitric oxide synthesis, in cooled arcs under reduced pressure, and in flames and explosions were not found suitable for technical application The judgment of the technical chemists of the Badische Gesellschaft had been at fault, since ammonia synthesis was ultimately a very real solution of the problem of the economic utilization of atmospheric nitrogen

Ramsay and Young in 1884 had found that with nitrogen and hydrogen in presence of iron at 800° centigrade, no ammonia was produced This was found to be incorrect and traces of ammonia were detected Other catalysts were tried, and from the results it was evident that an equilibrium state was attained, from which it was possible to calculate the yields at other temperatures and pressures. No further progress was made, however, since it was judged by the technical experts to be impossible to carry out the reaction on the large scale at the temperatures required and under the very high pressures indicated by the calculations.

In 1906, measurements under pressure were for the first time carried out by Nernst and Jellinek, and in 1908, Haber in conjunction with Dr Le Rossignol began experiments at higher pressures. The technical chemists were still unfavorably inclined towards the process, although practical yields had now been reached. By the use of new catalysts the temperature was lowered to 500-600° under a pressure of 200 atmospheres. In 1913, the process was taken up by the Badische Gesellschaft, but an account of the main scientific results was also published. The work of Dr Bosch speedily led to the successful introduction of the synthetic ammonia process, and in the period 1913-1920 the capacities of the German factories rose from nothing at all to 1,500,000 tons per year

For Vending Grease and Oil

A NEW machine for the vending of thick oil and greases, especially to automobiles, is being put upon the market. It consists of an easily moveable frame supporting an inflatable container, or tank, holding about 50 pounds of lubricant upon a specially designed forward and backward registering scale which shows at once the totals and units contained and sold. This scale is fitted with a protecting release From the bottom of the tank extends a hose ending in a special spring nozzle for safe delivery of contents to car or container The makers claim that the machine weighs all materials in and out exactly that it is cleanly, easily movable and dirt-excluding, that it will deliver any specified amount of contents to any gear box exactly, and will check up sales or contents at any time exactly

An oil- and grease-vending machine that gives accurate measure

The Heavens in January, 1924

Some Facts and Some History About the Infant Class of the Solar System

By Professor Henry Norris Russell, Ph D

IN THE present state of astronomy, discoveries within our solar system are relatively rare, and circumscribed in their scope. All the greater worlds appear to have been already conquered and those which remain to be found are so small that we can hardly call them "worlds" at all, though the title of planets we cannot deny them

Of these little ones, enough and to spare are already known. Since Piazzi discovered Ceres, on the first day of the nineteenth century the list of the asteroids has steadily grown—slowly at first, then faster, and finally in the last three decades by leaps and bounds, until the number of those whose orbits are known well enough to justify listing and naming them is close to a thousand

In the old days of visual observation it was no easy matter to discover a new planet—though we know that there were plenty to be found The observer had to make himself a chart of some likely region of the sky (along the ecliptic, near which all the larger planets lie), by weeks of labor and then he had to go over this region again and again, looking for any faint star like speck which was not upon his map and which might then turn out to be a planetoid which had moved into the field since the year before

But nowadays we apply the principle of scientific management We work by machinery, and it might almost be said that certain astronomers engage in "quantity production" of asteroid discoveries The method of this change is, of course photographic If we use a suitable lens giving us good star images over a wide field of the sky, our chart, which is as necessary as ever, is made automatically for us in a couple of hours' exposure—and far more accurately and completely than could be done by the old method in a *month's* labor Comparison of two plates, taken at different times, will reveal any planet which has invaded our field and this comparison too can be made mechanically by the aid of that ingenious instrument, the blink microscope Here we put the two plates into our apparatus, and so adjust them that the same region, as pictured on the one or the other, can be seen alternately by shifting a little mirror without moving the eye from the eye-piece Make this alternation of images rapid and put the plates in their carriers so that the star images in the two appear in the same position in the field of view then the stars will appear fixed while any object which has moved, or changed in brightness between the two dates of exposure will seem to flicker or 'blink" in a very conspicuous fashion To pick out a few such objects among ten thousand stars, or more, becomes then an easy matter

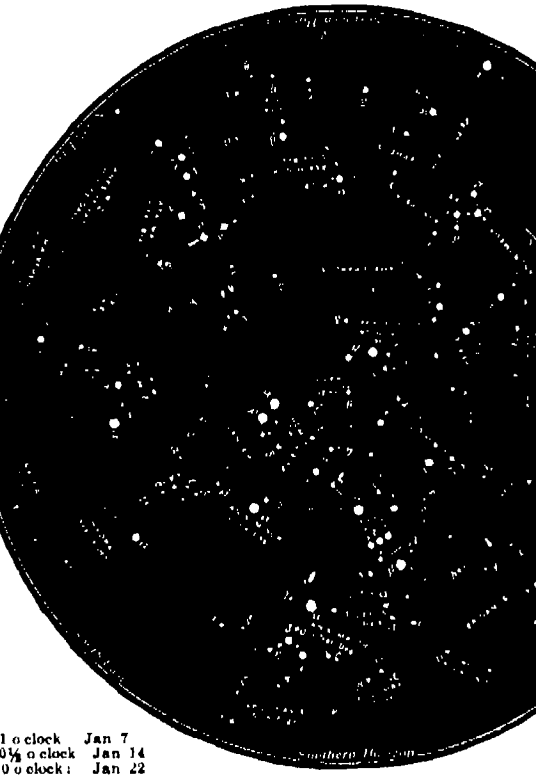
Quantity Production of Asteroids

But the asteroid hunter need not even go to the trouble of providing himself with this somewhat costly accessory He can make the asteroid identify itself All that is requisite is to prolong the exposure over several hours—guiding the while with an auxiliary telescope to make sure that the camera remains always pointed exactly right. The star images are then round black dots upon the negative, while the moving asteroids appear as streaks, or trails The off chance of mistaking a defect in the photograph for a planet may be eliminated by using a pair of cameras and photographing the region in duplicate

Yet this device is imperfect,—for the light of the stars which we are not concerned with is concentrated into sharp images on our plate, while that of the asteroids which we are hunting is spread out into a trail—so that the fainter ones may be lost Better results can be obtained by adjusting the movement so that the camera follows, not the stars, but a point moving at the average rate at which an asteroid might be expected to shift its position The stars will then be drawn out into trails and the planets will appear as dots (or as short trails if they are not moving quite at the estimated rate or in the estimated direction)

In this way the discovery of these tiny bodies becomes a matter of routine It is almost *too* easy to discover them—at least many of those that are so found get lost again To calculate an orbit with whose aid we can relocate and reobserve the planet a year or two later, we must have observations—at least three in number—separated by a fortnight or so Too often the moon comes around fogging the plate with its light or bad weather intervenes and when the next good chance comes the newly discovered planet can no longer be found—perhaps because we have not looked for it in the right place perhaps because it has grown fainter

The number of planets which have thus been found only to be lost again runs far into the hundreds They are not *permanently* lost though Very often when a good orbit can be calculated for a newly discovered planet it is found calculating backward that it has been observed before (sometimes twice before) among



At 11 o clock Jan 7
At 10½ o clock Jan 14
At 10 o clock Jan 22

At 9 o clock Feb 6
At 8¼ o clock Feb 14
At 8 o'clock Feb 21

At 9½ o clock Jan 29

NIGHT SKY JANUARY AND FEBRUARY

the 'lost objects' and that the old observations can now be used to their full value

Sometimes a planet gets away from us even after it has been observed well enough to permit an orbit to be calculated A first orbit based on a few observations, is never very accurate Small errors in the original measures are enormously magnified by the extrapolation to the next opposition and the planet when found again is usually not *at* the predicted place but *near* it If, however, it is not picked up again for three or four years this uncertainty may grow to such a degree that we are at a loss where to look and may not pick it up at all

Planetoidal Prodigals

Several "lost planets of this sort were found among the earlier discoveries, made by direct observation One by one however they have been picked up again unexpectedly by the powerful modern means of discovery—their identity becoming known only when their orbits were computed afresh and found to coincide with those of one or another of the lost planets A particularly interesting case of this kind happened about a year ago

Professor Watson in the year 1873 discovered an asteroid of moderate brightness, for which he obtained observations covering three weeks' interval, and computed an orbit and to which he gave the classical name Aethra It was seen at once to be remarkable on account of the great inclination of its orbit nearly 25 degrees, and its great eccentricity 0.38, which made its minimum distance from the sun less than half its maximum At the next couple of observations the planet was not observed probably because it was much farther from the sun and fainter—and later it could not be found at all and was put upon the missing list where it remained for nearly forty years Why this happened was shown clearly in 1910, by the calculations of Alter who found that by small changes in the observed positions quite within the possible errors of observation the calculated period might be changed by two or three months either way—enough to amount to a whole revolution since the discovery and loss of the planet. Nothing but a happy chance could find it again and the chance happened in December, 1922

At this time the asteroid came to perihelion when the earth was on the near side of the sun and so looked brighter than it had for years—and it is a gratifying evidence of the efficiency of our astronomical patrols that it was discovered independently by three observers—in Russia in Algiers and at Washington A month or two later when its orbit had been calculated it became quite clear that it was following just the same path as the planet lost in 1873 and was indeed the missing Aethra This rediscovery leaves no gap among the first two hundred asteroids to be discovered all the lost ones being now returned to the fold

Aethra itself is rather out of the usual run of these little planets Its period is of average length—four years and one fifth—and its average distance from the sun 250 million miles is not remarkable but its great eccentricity brings it at perihelion within 155 million miles of the sun and nearer than all but two or three of the thousand others while its aphelion distance of 345 million miles is again exceeded by but a few At a perihelion opposition—which we came close to having a year ago—it is but sixty million miles from the earth and appears brighter than the ninth magnitude which is pretty bright for an asteroid At aphelion even at opposition it is fainter than the thirteenth magnitude This is far from placing it out of reach of powerful instruments once we know where to look for it but explains why it was not picked up by chance until it came near her again Its actual diameter may be roughly estimated at fifty miles which is more or less like the general run of asteroids

The planet has been well observed during the past year and there is no danger of its getting lost again Theoretical workers will have a fine time with it, both in calculating its orbit and in working out the perturbations due to attraction of the planets in the forty year interval since its first discovery The rather costly calculations involved can be financed in this case for Professor Watson who discovered about a dozen other asteroids provided in his will for a trust fund to take care of future observations and calculations regarding them

The Planets

The star map will have to stand on its own feet this month Mercury is an evening star until the 12th and a morning star after that date but is too near the sun to be seen except at the very beginning of the month and near its close Venus an evening star is becoming conspicuous She sets at 6 50 P M on the 1st and at 8 P M on the 31st, and is far brighter than anything else in sight Mars is a morning star in Libra and Scorpio rising about 3 15 A M in the middle of the month Jupiter too is in Scorpio about 15 degrees farther east and rises an hour or so later Saturn is in Virgo and comes into quadrature west of the sun on the 23rd Uranus is in Aquarius setting at 9 P M in the middle of the month Neptune in Leo is approaching opposition, and observable most of the night

Gasoline Cars and Trucks of 1924

THE purpose of the accompanying chart of motor-car prices is to enable the man who knows approximately how much he can spend for a car to see at a glance what cars fall within the price range which he has in mind. Sufficient data are given with reference to the engine and the chassis to indicate in a general way the size and power of the car, but these items are only incidental to the main purpose of the table. The arrangement of the chart is different from that which we have used for a similar purpose in past years and will, we believe, make it easier to put the table to the purpose for which it is intended.

Under each of the major heads "Two Cylinders," "Four Cylinders," etc., the entries are arranged strictly according to the price of the standard open model. This may be assumed to accommodate five passengers, unless the price is followed by the figure "4" or "7." In view of the very large place occupied in today's motor market by closed models the price is also stated for the standard closed model with the same convention regarding passenger-capacity. The entries in this column, however, necessarily are somewhat out of numerical order since their arrangement must follow that of the open cars. In the final column an attempt is made to indicate what other bodies than the standard phaeton (touring car) and sedan are offered. The abbreviations used in this column are R (roadster, speedster, etc.), C (coupe), B (brougham), Sp (sport models), S (sedan or similar closed models aside from the standard sedan), 7 (seven-passenger open or closed models excluded from the two preceding columns by the presence there of five-passenger bodies), Lim (limousine). In some cases the number of bodies offered and the difficulty of classification are such that we have simply remarked "Various."

The data are for the better part supplied by the manufacturers. In cases where the maker has failed to respond to repeated request for the information and where we are assured that the car is really on the market, we have compiled the missing data with the cooperation of *Motor World*. In such instances the name of the car is preceded by an asterisk (*). The information then given pertains to the model that was being marketed on November 22nd—which may be that of 1924 or that of 1923.

The prices and other data, even when supplied by the manufacturers, are, of course, subject to error and to change without notice.

To the reader searching for a luxury car it should be pointed out that the last six entries among the four-cylinder models are separated from their predecessors by a very wide price-margin, are of large size and power and compete with six-cylinder cars of parallel price, rather than with the more reasonably priced fours. The man using the chart as his guide to the purchase of a first car will also observe that the more expensive of the ordinary fours and the less expensive of the sixes cover the same price-range, and that within this range both groups should be considered by a prospective purchaser.

PASSENGER CARS

TWO CYLINDERS

			S A E Rating	Wheelbase	Tire Size	Prices Standard Models: Open	Prices Standard Models: Closed	Other Models
Hanover	Hanover Pa		9.8	90	28 x 3	$ 250—2	$	None
FOUR CYLINDERS								
Ford	Detroit	Planetary Transmission	22.5	100	30 x 3½	380	685	R, C
Star	Lansing Mich		15.6	102	30 x 3½	400	785	R, C, Sp
Overland	Toledo O	Model "91"	19.6	100	30 x 3½	495	795	None
Chevrolet	Detroit		21.7	103	30 x 3½	495	795	R, C
*Gray	Detroit		21.0	100	30 x 3½	520	835	R, C, Sp
Metropolitan	Kansas City	Air Cooled, Two Speeds	11.3	108	30 x 3½	600	700	None
Sterling	New London Conn		27.4	110	31 x 4	685		None
Overland	Toledo O	Model "92"	19.6	106	30 x 3½	695		None
Maxwell	Detroit		21.0	109	31 x 4	795	1195	Various
Dodge Bros	Detroit		24.0	116	32 x 4	880	1250	S
Dort	Flint, Mich		19.6	108	31 x 4	885	1350	R, C Sp
Durant	New York		24.1	109	31 x 4	890	1365	Various
Nash	Kenosha Wis	Also Sixes	18.2	112	33 x 4	935	1445	Various
Buick	Flint Mich	Also Sixes	18.2	109	31 x 4	965	1495	C, R
National	Louisville Ky	Also Sixes	19.6	112	32 x 4	975	1175	C, Sp
Champion	Philadelphia		19.6	112	32 x 4	975	1295	None
Seneca	Fostoria O		22.3	112	31 x 4	985		R
Elcar	Elkhart Ind	Also Sixes	21.0	112	31 x 4	995	1425	B Sp S
Gardner	St Louis		21.7	112	32 x 4	995	1445	Various
Bush	Chicago	Also Sixes		112	31 x 4	1065	1525	B
*Earl	Jackson Mich		18.9	112	32 x 4	1095	1595	R, C, Sp
Kelsey	Belleville N J		21.0	112	32 x 4	1150	1450	None
Willys Knight	Toledo O	Model "64" Sleeve Valves	21.0	118	32 x 4	1175	1450	None
Hupmobile	Detroit		16.9	115	32 x 4	1175	1750	R, C, Sp
Moller	Hagerstown M		12.0	100	27 x 3½	1200		R
Willys-Knight	Toledo O	Model "67" Sleeve Valves	21.0	124	32 x 4½	1325—7	1995—7	None
*Stearns Knight	Cleveland	Sleeve Valves, Also Sixes	22.5	125	34 x 4½	1595	2195	Various
H C S	Indianapolis	Also Sixes	22.5	120	32 x 4½	2250		None
*Stutz	Indianapolis	Also Sixes	30.6	130	32 x 4½	2700	3490	Various
Revere	Logansport Ind		30.6	131	32 x 4½	3200	4000	R, Sp
Roamer	Kalamazoo Mich	Also Sixes	28.9	126	32 x 4½	3485	4650	R, 7 Sp
*Rubay	Cleveland		12.1	118	32 x 4		5100	None
Brewster	Long Island City N Y		25.6	125	32 x 4½		7500	Var, Closed
SIX CYLINDERS								
Oldsmobile	Lansing Mich		18.2	110	31 x 4	750	1095	Various
Essex	Detroit	By Hudson Co New Six	16.0	110½	31 x 4	850	975	None
Sterling	New London Conn		29.0	114	33 x 4	850	985	None
Oakland	Pontiac Mich		18.9	113	31 x 4	945	1395	C
Columbia	Detroit	"Light Six"	23.1	115	31 x 4	995	1495	C, S, Sp
Studebaker	South Bend Ind	"Light Six"	23.5	112	31 x 4	995	1550	R, C
Dort	Flint Mich		23.4	115	31 x 4	1025	1465	R, C, Sp
Cleveland	Cleveland		22.6	112	31 x 4	1045	1365	Various
Jewett	Detroit	By Paige Co	25.4	112	31 x 4	1065	1495	R, C, Sp
Auburn	Auburn Ind	Model "6-43"	24.4	111	31 x 4	1095	1595	C, Sp
*Chalmers	Detroit	By Maxwell Co Short Models	25.4	117	32 x 4	1185	1535	Sp
Flint	Flint Mich		27.3	120	32 x 4½	1195	1985	R, C, Sp
Anderson	Rock Hill S C	Model "41"	23.4	115	32 x 4	1195	1695	Various
Nash	Kenosha Wis	Short Models Also Fours	25.4	121	33 x 4	1240	2040	Various
Velie	Moline Ill		24.4	118	32 x 4	1275	1895	Various
Hudson	Detroit		29.6	126	34 x 4½	1295	1375	7 S etc
Stephens	Freeport Ill	Model "10"	25.3	117	32 x 4	1295	1595	R, S, Sp
Buick	Flint Mich	Short Model Also Fours	27.3	120	32 x 4	1295	1995	R, S
Moon	St Louis	Model "6-40"	23.4	115	31 x 4	1295	1695	R, C, Sp
Davis	Richmond Ind		23.4	115	31 x 4	1295	1795	R
Haynes	Kokomo Ind		29.4	121	32 x 4½	1295	1895	R, S, Sp
*Courier	Sandusky O		23.4	116	32 x 4	1295	1895—7	Various
*Chalmers	Detroit	By Maxwell Co Long Models	25.4	122	32 x 4	1295—7	2005—7	None
Reo	Lansing Mich		24.3	120	32 x 4 33 x 4½	1335	1985	Sp C B
Studebaker	South Bend Ind	"Special Six"	29.4	119	32 x 4	1350	2050	R, C
*Paterson	Flint Mich		27.3	120	32 x 4½	1390	2395	R, C Sp 7
Barley	Kalamazoo Mich	By Roamer Co	23.4	118	32 x 4	1395	1850	S Sp
Elcar	Elkhart Ind	Also Fours	27.3	118	32 x 4	1395	1995	S, B Sp
Huffman	Elkhart Ind		27.3	120	32 x 4	1395	2295	R, Sp
Bush	Chicago	Also Fours		118	32 x 4	1445		None
Chandler	Cleveland	New gear-shift see page 7	29.4	123	32 x 4 33 x 4½	1485	1785	R, 7, Sp 7, Lim
Beggs	Kansas City			120	33 x 4	1495		None
Moon	St Louis	Models "6-50"	23.4	118	31 x 4	1495	1885	R, C, Sp
Hanson	Atlanta Ga		27.3	121	32 x 4	1495	1995	None
Rour Davis	Shreveport La		29.0	126	33 x 4½	1500		7
Columbia	Detroit	"Big Six"	27.3	115	32 x 4		1995	C
Apperson	Kokomo Ind	Also Eights	24.0	120	32 x 4	1585	2200	None

Buick	Flint, Mich.	Long Model, Also Fours	27.3	128	32 x 4½	1565—7	2285—7	Various
Kissel	Hartford, Wis.		26.3	121	32 x 4	1585	2585	Various
Westcott	Springfield, O		27.4	120	32 x 4½	1590	2190	B Sp
Kline	Richmond, Va.		27.5	121	33 x 4	1590	2590	C Sp
Stephens	Freeport, Ill.	Model "20"	25.3	124	33 x 4½	1595—7	2250—7	Sp
Auburn	Auburn, Ind	Model "6-63"	25.4	122	32 x 4½	1595	2345	B, Sp
Anderson	Rock Hill, S C	Model "50"	27.3	122	32 x 4	1595—7		None
*Rickenbacker	Detroit		23.4	117	32 x 4	[illegible]	2135	None
*Jordan	Cleveland	Model "MX"	26.3	120	32 x 4	1675	2285	R, C
*Pilot	Richmond Ind		25.4	126	32 x 4½	1695	2495	Various
Studebaker	South Bend, Ind	Big Six	38.2	126	33 x 4½	1750	2750	R C
Hatfield	Sidney, N Y		25.4	121	32 x 4	1775		None
					33 x 4½		2275	S
Moon	St. Louis	Model "6-58"	27.3	128	32 x 4½	1785—7	2485—7	S Sp
*American	Plainfield N J		29.4	127	33 x 4½	1785	2485	Various
*Washington	Eaton O		27.3	116	32 x 4	1785		None
*Case	Racine, Wis	Model "X"	27.3	122	32 x 4½	1790	2575	R C Sp
*Lexington	Connersville, Ind		25.4	123	32 x 4½	1795	2345	Various
Kurtz	Cleveland			122	33 x 4½	1845	2350	None
Franklin	Syracuse, N Y	Air Cooled	25.3	115	32 x 4	1950	2850	Various
Sterling Knight	Warren, O	Sleeve Valves	25.4	125	32 x 4½	1985	2800	B Sp
*Stutz	Indianapolis	Also Fours	27.3	120	32 x 4	1995	2550	R Sp
*Jordan	Cleveland	Models H I	26.3	121	32 x 4½	1995	2585	None
R & V Knight	East Moline Ill	Sleeve Valves	29.4	124	32 x 4½	2300	3050	C, 7, Sp
National	Indianapolis	Also Fours	29.4	130	32 x 4½	2375—7	3250—4	R C 7
*Stearns Knight	Cleveland	Also Fours	27.3	130	34 x 4½	2395	3495	Various
Paige	Detroit		33.8	131	33 x 4½	2450	[illegible]	7, B Lim
*Case	Racine Wis	Model Y	31.5	132	33 x 5	2475—7	3325—7	None
Packard	Detroit	Model 126 Also Eights	27.3	126	33 x 4½	2485	3275	Various
Holmes	Canton, O	Air Cooled	29.4	126	34 x 4½	2500—7	3000—7	C, R, S
*Noma	New York		27.3	128	33 x 5	2500—4	3500—5	R 7
Premier	Indianapolis		27.3	126¼	32 x 4½	2585	3585	R B, 7
H C S	Indianapolis	Also Fours	29.4	120	32 x 4½	2650	3350	None
Packard	Detroit	Model 133 Also Eights	27.3	133	33 x 4½	2685—7	3525—7	Various
Roamer	Kalamazoo Mich	Short Model Also Fours	29.4	128	32 x 4½	2685	3585	Various
Marmon	Indianapolis		33.8	136	32 x 4½ / 33 x 5	2785—4 7	3085—5	Various / Various
Fox	Philadelphia	Air Cooled	27.3	132	32 x 4½	2975	3975	C
Crawford	Hagerstown Md		31.5	138	33 x 5	3100	4500	None
Crawford Dagmar	Hagerstown Md		31.5	138	33 x 5	3[illegible]00	4500	Sp
Winton	Cleveland		33.8	132	33 x 5	3600	4250	Various
Mercer	Trenton, N J	Short Models	33.8	115	32 x 4½	3750		None
Roamer	Kalamazoo Mich	Long Model Also Fours	29.4	138	32 x 4½	3950	4250	None
Mercer	Trenton, N J	Long Models	33.8	132	33 x 5		4700—7	Sp
Dorris	St Louis		38.4	132	33 x 5	4150	5500	C 7
Wasp	Bennington, Vt		31.5	144	33 x 5	4500—4		None
Pierce Arrow	Buffalo		38.4	138	33 x 5	5250—4 7	6900—4	Various
McFarlan	Connersville Ind		48.6	140	33 x 5	5600	6900	Various
Stevens-Duryea	Chicopee Falls Mass		47.0	138	33 x 5 / 35 x 5	7500—7	9675—7	Various / Various
Locomobile	Bridgeport		48.6	142	35 x 5		7900	Var closed
*Rolls Royce	Springfield, Mass		48.6	143½	33 x 5	10000	12800	Various

EIGHT CYLINDERS

*King	Detroit	Model "LL"	28.8	120	32 x 4½	1595	1995	Various
*King	Detroit	Model "L"	28.8	124	32 x 4½	1795	2295	Various
Cole	Indianapolis		39.2	127¼	33 x 5	2175	3075	C
Wills Ste Claire	Marysville, Mich		39.0	127	32 x 4½	2475—7	3475—7	Sp
Standard	Butler, Pa		33.8	127	34 x 4½	2500	3400	None
Peerless	Cleveland		33.8	128	33 x 5	2690	3690	None
Apperson	Kokomo Ind	Also Sixes	33.8	130	32 x 5	2800	3750	None
Cadillac	Detroit		31.3	132	32 x 5	2985	3950	Various
Packard	Detroit	Model 136, Straight Eight	36.4	136	33 x 5	3650	4650	R C Lim
Lincoln	Detroit	By Ford Co	36.4	136	33 x 5	3800—4 7	4700	Various
Packard	Detroit	Model "143" Straight Eight	36.4	143	33 x 5	3850—7	4900—7	Lim
Lafayette	Milwaukee		33.8	132	33 x 5	5000	6500	R 7
Cunningham	Rochester, N Y	Open Model	45.0	132	33 x 5	6200		Various
Duesenberg	Indianapolis	Straight Eight	26.5	134	33 x 5	6250	7800	Various
Cunningham	Rochester N Y	Closed Models	45.0	142	33 x 5		7600	Various

COMMERCIAL VEHICLE

We have been unable satisfactorily to classify these trucks speed wagons etc into several groups according to their tonnage ratings The ambiguity of many ratings (1½-2 tons, 2½-3, etc, etc), and the degree to which these ambiguous ratings overlap each other and overlap any limits which might be set for the several groups makes such an attempt out of the question We have finally concluded that the average truck buyer using this list as a guide will feel that the price he can pay lies within more rigid limits than does the capacity of the vehicle which he requires, and that therefore the best ends will be served by a single list in which all commercial vehicles will be entered in the order of their price. Attention is called to the unpriced trucks of numerous makes listed at the end

Practically all truck manufacturers put out vehicles of various capacities and so will be found at various points in the list No attempt at cross references is made in this connection. Those trucks which are made in but one model are indicated by a dagger (†) Some prices are for chassis only and others include cabs etc but we have not this information in enough cases to attempt its inclusion

Ford	Detroit	1	22.5	$ 370†
Overland	Toledo	½	19.6	395†
*Star	Lansing, Mich	¾	15.6	405†
Chevrolet	Detroit	½	21.7	495
Chevrolet	Detroit	1	21.7	550
*Gray	Detroit	1		575
*Dort	Flint, Mich	½	19.6	685†
Ruggles	Saginaw	¾	19.6	795
Champion	Philadelphia	½		895†
Dodge	Detroit	¾	24.0	895†
*Vim	Philadelphia	½ ¾	25.6	995†
Oldsmobile	Lansing, Mich.	1		1095†
Stewart	Buffalo	1	22.5	1095
*Maxwell	Detroit	1½	21.0	1097†
Sullivan	Rochester, N Y	1	22.5	1100
Kearns	Danville, Pa	1	19.6	1150
Reo	Lansing, Mich	1¼		1185
Perfection	Minneapolis	¾	19.6	1245
Ruggles	Saginaw Mich	1¼	25.6	1245
Corbitt	Henderson, N C	¾-1	19.6	1250
Graham Bros.	Detroit	1	24.0	1265
Triangle	St. Johns, Mich	1	19.6	1285
Roadking	Flint, Mich	1½	25.6	1295†
Graham Bros.	Detroit	1½	24.0	1325
Standard	Detroit	1¼	22.5	1330
Wilson	Detroit	1	25.2	1350
Patriot	Havelock, Neb.	1	22.5	1357
Gramm Pioneer	Lima, O	1¼	22.5	1365
Bethlehem	Allentown, Pa	1	19.6	1385
Noble	Kendallville, Ind	1	22.5	1395
Parker	Milwaukee	1	22.5	1400
*Bessemer	Philadelphia	1	19.6	1450
All-American	Fremont, O	1	19.6	1465
Corbitt	Henderson, N C	1	22.5	1480
Denby	Detroit	1¼	22.5	1485
Master	Chicago	1¼	22.5	1497
Duplex	Lansing, Mich	1	22.5	1495
Bell	Ottumwa, Ia	1	22.5	1495
Stewart	Buffalo	1¼-1½	22.5	1495
L. M. C.	Shreveport, La	2½		1500†
Belmont	Lewistown Pa	1	22.0	1525
Perfection	Minneapolis	1¼	22.5	1545
Pioneer	Chicago	1	22.5	1550†
Kissel	Hartford Wis	1		1585
Garford	Lima O	1	21.0	1590
*Nash	Kenosha Wis	1 1½		1595
Watson	Canastota N Y	1	22.4	1600†
*Dearborn	Chicago	1		1600
Henderson Bros	Cambridge Mass	¾		1650
K Z	Chicago	¾	22.5	1650
G W W	Henderson Ia	1 1½		1650†
Kearns	Danville Pa	1½	19.6	1650
D Olt	Woodhaven N Y	1	19.5	1695
Gotfredson	Detroit	1	22.5	1695
Sandow	Chicago H'ts, Ill	1	19.6	1695
Standard	Detroit	1½	22.5	1695
Huffman	Elkhart Ind	1½	22.5	1695
Traffic	St Louis	2	22.5	1695
Gramm Pioneer	Lima O	1½	22.5	1700
Traffic	St Louis	1½	22.5	1750
O K	Okay Okla	1½	22.5	1750
*Gary	Gary Ind	1		1775
Clydesdale	Clyde O	¾ 1¼	22.5	1785
Larrabee	Binghamton N Y	1¼	27.3	1785
Velie	Moline Ill	1½ 2	22.5	1785†
Huffman	Elkhart Ind	1½ 2	22.5	1795
Moreland	Burbank Cal	1	25.6	1800
Kankakee	Kankakee Ill	1½	22.5	1800
Wisconsin	Madison Wis	1½	22.5	1850
Betz	Hammond Ind	1	22.5	1850
Hurlburt	Harrisburg Pa	1	22.5	1850
Dart	Waterloo Ia	1½	22.0	1850
D-Olt	Woodhaven N Y	2	21.0	1850
Stewart	Buffalo	1½ 2	22.5	1870
U S	Cincinnati	1¼	22.5	1875
Eagle	St Louis	1 1½	22.5	1875
Noble	Kendallville Ind	1½	22.5	1890
Sandow	Chicago H'ts, Ill	1½	22.5	1895
Ruggles	Saginaw Mich	2	25.6	1895
Wilcox Trux	Minneapolis	1	22.0	1900
Krebs	Bellevue O	1	22.5	1900
Maccar	Scranton, Pa	1 1½	25.6	1900
All American	Fremont O	1½	19.6	1915
K Z	Chicago Ill	1	22.5	1950
Columbia	Pontiac Mich	1½		1950
Rainier	Flushing N Y	¾	22.5	1970
Kissel	Hartford Wis	1½		1975
Keystone	Oaks Pa	2	22.5	1975†
*Dearborn	Chicago	1½		1980
Duplex	Lansing Mich	1½	22.5	1985
Triangle	St Johns Mich	1½	22.5	1985
*Bessemer	Philadelphia	1½	22.5	1995
Henderson Bros	Cambridge Mass	1		2000
O K	Okay Okla	1½ 2	25.6	2000
Bell	Ottumwa Ia	1½	22.5	2100
*Tiffin	Tiffin O	1½ 2	27.2	2100
Traffic	St Louis	3	22.5	2145
Rainier	Flushing N Y	1	22.5	2150
Concord	Concord N H	1	22.0	2150
Parker	Milwaukee	1½	25.6	2150
Rumely	La Porte Ind	1½ 2	22.5	2150†
*Nash	Kenosha Wis	2 2½		2150
Corbitt	Henderson N C	1½	22.5	2170
Gramm Pioneer	Lima O	1½	22.5	2175
Bethlehem	Allentown Pa	2	25.6	2185
Autocar	Ardmore Pa	1½ 2	18.0	2200
Kearns	Danville Pa	2	25.6	2200
U S	Cincinnati	1½	22.5	2225
Hal Fur	Cleveland	1	25.6	2250
Kenworth	Seattle	1	22.5	2250
Available	Chicago	1½	26.4	2250
Henderson Bros	Cambridge, Mass	1½		2250
*Nash	Kenosha Wis	2½		2250
Wilson	Detroit	1½	22.5	2270
K Z	Chicago	1½	22.5	2275
Triangle	St Johns Mich	2	22.5	2285
Ruggles	Saginaw	2½	25.6	2295
All American	Fremont O	2 2½	19.6	2345
Clydesdale	Clyde O	1 1½	22.5	2350
Moreland	Burbank Cal	1½	25.6	2350

*Dependable	E. St. Louis, Ill	1½ 2		2350
Garford	Lima, O	1½	22.5	2375
Selden	Rochester, N Y	1½ 2½	22.5	2375
Denby	Detroit	2	22.5	2375
*Traylor	Allentown, Pa	1½		2390
*Dearborn	Chicago	2		2390
Eagle	St. Louis	2-3	25.6	2395
White	Cleveland	¾	22.5	2400
Wachusett	Fitchburg Mass	1	27.3	2400
Gotfredson	Detroit	1½	25.6	2400
Patriot	Havelock Neb	2	25.6	2400
Twin City	Minneapolis	2	25.6	2400
D Olt	Woodhaven N Y	2½	24.0	2400
Duplex	Lansing, Mich	2	26.5	2445
Available	Chicago	1½	26.4	2450
*Gary	Gary, Ind	2		2450
Columbia	Pontiac, Mich	2½		2460
Larrabee	Binghamton, N Y	1½ 2½	27.3	2465
Atterbury	Buffalo	1½ 2	22.5	2475
Dorris	St Louis	1	25.6	2490
Sullivan	Rochester N Y	1½	22.5	2500
Schacht	Cincinnati	1½	25.6	2500
Brinton	Philadelphia	1½	25.0	2500
Walker Johnson	Woburn, Mass	1½	22.0	2500
Hurlburt	Harrisburg, Pa	1½ 2	20.0	2500
*Hendrickson	Chicago	1½		2525
U S	Cincinnati	2	22.5	2525
Wilcox Trux	Minneapolis	1½ 2	20.0	2550
Armleder	Cincinnati	1½ 2½	25.6	2550
Bell	Ottumwa, Ia	2½	28.7	2550
Belmont	Lewistown, Pa	2	28.9	2575
Corbitt	Henderson N C	2	27.5	2585
Master	Chicago	1½	27.2	2590
Rainier	Flushing N Y	1½ 2	22.5	2590
Kankakee	Kankakee Ill	2½	27.2	2590
Stewart	Buffalo	2½ 3	20.0	2590
Traffic	St Louis	4	22.5	2595
Krebs	Bellevue O	1½	27.2	2600
Hal Fur	Cleveland	1½	25.6	2600
Ace	Newark O	1½	22.0	2600
Concord	Concord N H	1½	22.0	2600
Harvey	Harvey Ill	2	28.9	2650
Clydesdale	Clyde O	2 2½	27.2	2650
Gramm Pioneer	Lima O	2½	27.2	2650
Perfection	Minneapolis	2½	27.2	2650
Noble	Kendallville Ind	2	22.5	2690
Huffman	Elkhart, Ind	2½ 3	28.9	2695
*Titan	Milwaukee	2½		2700
Wisconsin	Madison Wis	2	27.2	2700
*Tiffin	Tiffin O	2½ 3		2700
Kalamazoo	Kalamazoo Mich	1½	22.0	2750
De Martini	San Francisco	1½	22.0	2750
Buffalo	Clarence, N Y	2	25.6	2750
Available	Chicago	2	26.4	2750
*Nash	Kenosha Wis	2 2½		2750
Sandow	Chicago H ts, Ill	2½	27.2	2750
Triangle	St Johns, Mich	2½	25.6	2785
Standard	Detroit	2½ 3½	27.2	2795
Front Drive	Bnton H b r Mich	1½	22.5	2800
Wachusett	Fitchburg Mass	1½	22.5	2800
Dart	Waterloo Ia	2½	27.7	2800
Oneida	Green Bay	1¾	25.6	2825
Wilson	Detroit	2½	27.2	2825
Moreland	Burbank Cal	2	27.2	2850
*Traylor	Allentown Pa	2		2850
*Gary	Gary Ind	2½		2850
Krebs	Bellevue O	2½	32.4	2850
Selden	Rochester, N Y	1½ 2½	27.2	2875
Kissel	Hartford Wis	2½		2875
K Z	Chicago	2½	27.2	2875
Acason	Detroit	2	25.6	2890
*Bessemer	Philadelphia	2½		2895
Maccar	Scranton Pa	1½	25.6	2900
Harvey	Harvey Ill	2½	28.9	2950
O K	Okay Okla	2½ 3	28.9	2950
*Dependable	Chicago	2½ 3		2950
Columbia	Pontiac Mich	3		2950
Corbitt	Henderson N C	2½	27.5	2970
Duplex	Lansing Mich	2½	26.5	2975
Sullivan	Rochester N Y	2½	28.9	2975
Clydesdale	Clyde O	2½ 3½	27.2	2975
Denby	Detroit	3	27.2	2975
Oshkosh	Oshkosh Wis	2	25.6	2985
Betz	Hammond Ind	2½	29.0	2985
Bethlehem	Allentown Pa	3	25.6	2985
*Rowe	Lancaster Pa	1½		3000
Mack	New York	1½	25.6	3000
Fageol	Oakland Cal	1½ 2	22.5	3000
Parker	Milwaukee	2	25.6	3000
Witt Will	Washington	2	27.2	3000
Wilcox Trux	Minneapolis	2½	29.0	3000
Patriot	Havelock Neb	3	32.4	3000
Rainier	Flushing N Y	2 2½	27.2	3090
Kenworth	Seattle	1½	25.6	3100
Autocar	Ardmore, Pa	2 3	25.6	3100
Wisconsin	Madison Wis	3	32.4	3100
Union	Bay City Mich	2½	25.6	3150
Noble	Kendallville Ind	2½	28.9	3150
Hurlburt	Harrisburg Pa	2½ 3	29.0	3150
Armleder	Cincinnati	2½ 3½	28.9	3150
Available	Chicago	2½	26.4	3160
Gotfredson	Detroit	2½	28.9	3175
Corbitt	Hend s n N C	2½ 3	32.4	3195
White	Cleveland	¾	28.9	3200
Schacht	Cincinnati	2	25.6	3200
Wachusett	Fitchburg Mass	2	27.2	3200
*Hendrickson	Chicago	2½		3200
Oneida	Green Bay, Wis	2½	25.6	3200
Olympic	Tacoma Wash	2½	28.0	3200†
D Olt	Woodhaven N Y	3½	31.0	3200
Sterling	Milwaukee	1½	30.6	3240
Garford	Lima O	1½ or 2½	29.0	3250
White	Cleveland	2	22.5	3250
Ultimate	Hillside N J	2	28.9	3250
Concord	Concord N H	2	25.6	3250
Ace	Newark O	2 or 2½	32.0	3250
De Martini	San Francisco	2 2½	29.0	3250
American	Portland Conn	2½		3250
Hal Fur	Cleveland	2½	28.9	3250
Selden	Rochester N Y	2½ 3½	27.2	3250
Witt Will	Washington	3	27.2	3250
Master	Chicago	2½	28.9	3290
Ward La France	Elmira, N Y	2½-3½		3290
*Rowe	Lancaster, Pa.	2		3300
Pierce-Arrow	Buffalo	2	25.6	3300
Northwestern	Seattle	2	27.8	3300
Mack	New York	2	28.9	3300
Northway	Natick, Mass	2 3	24.5	3300
Super-Truck	Waukegan, Ill	2½	25.6	3300
Clydesdale	Clyde, O	2½ 3½	32.4	3300
*Traylor	Allentown, Pa	3		3300
Gramm Pioneer	Lima O	3	28.9	3300
Acason	Detroit	3	25.6	3350
Atterbury	Buffalo	2½ 3	27.2	3375
U S	Cincinnati	3	25.6	3375
Dorris	St. Louis	2 2½	28.9	3400
Schacht	Cincinnati	2½	28.9	3400
Mack	New York	2½	28.0	3400
Sterling	Milwaukee	2	30.6	3440
Stewart	Buffalo	3½-4	32.4	3440
Mack	New York	1½	25.6	3450
Parker	Milwaukee	2½	28.9	3450
Lange	Pittsburgh	2½	27.2	3450
Buffalo	Clarence N Y	3	25.6	3475
*Bessemer	Philadelphia	4		3495
Old Reliable	Chicago	2½	28.9	3500
Wilcox Trux	Minneapolis	2½	29.0	3500
Kalamazoo	Kalamazoo, Mich	2½	30.0	3500
Northwestern	Seattle	2½	32.4	3500
Pierce Arrow	Buffalo	3	25.6	3500
Belmont	Lewistown, Pa	3	32.4	3500
Moreland	Burbank Cal	3	32.4	3500
Twin City	Minneapolis	3½	29.0	3500
Duplex	Lansing Mich	3½	29.2	3500
Rainier	Flushing N Y	2½ 3	27.2	3550
Selden	Rochester	2½ 3½	32.4	3550
Larrabee	Binghamton	2½-3½	32.4	3550
Krebs	Bellevue, O	3½	32.4	3550
Concord	Concord, N H	2½ 3	28.6	3600
Maccar	Scranton Pa	3	28.9	3600
Walker-Johnson	Woburn Mass	3	28.9	3600
*Titan	Milwaukee	3½		3600
*Tiffin	Tiffin, O	3½-4		3600
K Z	Chicago	3½	32.4	3625
Standard	Detroit	3½ 5	32.2	3645
Kissel	Hartford Wis	4		3675
Wilson	Detroit	3½	32.4	3685
Denby	Detroit	4	32.4	3695
Concord	Concord N H	2	28.6	3700
Sterling	Milwaukee	2½	30.7	3700
*Hendrickson	Chicago	3½		3725
Mack	New York	2	28.9	3750
Kenworth	Seattle	2½	28.9	3750
Garford	Lima, O	2½	32.4	3750
Ultimate	Hillside, N J	3	28.9	3750
Corbitt	Hend son, N C	3½ 4	32.4	3780
*Gary	Gary, Ind	3½		3790
Wachusett	Fitchburg Mass	2½	32.4	3800
*Traylor	Allentown Pa	3		3800
Schacht	Cincinnati	3	28.9	3800
Ace	Newark O	3	40.0	3800
Mack	New York	2½	28.9	3850
Noble	Kendallville, Ind	3½	32.4	3850
Krebs	Bellevue, O	3½	30.1	3850
Gramm Pioneer	Lima O	4	32.4	3850
Oshkosh	Oshkosh, Wis	2½	25.6	3885
Sandow	Chicago H ts, Ill	3½	32.4	3895
Fageol	Oakland, Cal	2½ 3	30.6	3900
American La France	Elmira, N Y	2½	28.9	3950
Wilcox Trux	Minneapolis	3½	32.4	3950
Harvey	Harvey Ill	3½	32.4	3950
O K	Okay Okla	3½ 4	32.4	3950
Union	Bay City, Mich	4	28.9	3950
Sullivan	Rochester, N Y	3½	32.4	3975
Clydesdale	Clyde O	3½ 5	32.4	3975
Kalamazoo	Kalamazoo Mich	3½	35.0	4000
Double Drive	Benton Harbor	4	32.4	4000
White	Cleveland	2	28.9	4050
Oneida	Green Bay Wis	3½	32.4	4050
U S	Cincinnati	4	32.4	4075
Doane	San Francisco	2½	31.0	4100
Larrabee	Binghamton	3½-4½	32.4	4100
*Titan	Milwaukee	5		4100
*Rowe	Lancaster, Pa	3		4150
Super Truck	Waukegan Ill	3½	28.9	4150
Hurlburt	Harrisburg Pa	3½ 4	32.0	4150
Acason	Detroit	4	30.6	4150
Armleder	Cincinnati	3½ 5	32.4	4150
Available	Chicago	3½	32.4	4175
Selden	Rochester	3½ 5	32.4	4175
Gotfredson	Detroit	4	32.4	4175
Master	Chicago	3½	32.4	4190
F W D	Clintonville, Wis	3	36.0	4200†
White	Cleveland	3½	28.9	4200
Northway	Natick Mass	3½ 5	24.5	4200
Clydesdale	Clyde, O	3½ 5	36.1	4200
Garford	Lima O	4	32.4	4200
Autocar	Ardmore, Pa	4 6	28.9	4200
De Martini	San Francisco	3 3½	29.0	4250
Hal Fur	Cleveland	3½	32.4	4250
Old Reliable	Chicago	3½	32.4	4250
Corbitt	Henderson, N C	5	36.9	4250
Atterbury	Buffalo	3½-4	32.4	4275
American	Portland, Ct	4		4275
Ward La France	Elmira, N Y	3½-5		4290
Parker	Milwaukee	3½	32.4	4300
*Tiffin	Tiffin O	5-6		4300
Wilcox Trux	Minneapolis	5	36.2	4350
Dorris	St Louis	3½	28.9	4400
Rainier	Flushing, N Y.	3½-5	32.4	4400
Schacht	Cincinnati	4	32.4	4400
Lange	Pittsburgh	3½	32.4	4450
Maccar	Scranton, Pa	4	32.4	4450
Gramm Pioneer	Lima, O	5	36.1	4450
*Gary	Gary, Ind	5		4450
Selden	Rochester	3½-5	36.1	4475
Master	Chicago	5	32.4	4490
Standard	Detroit	5	36.4	4495
Kenworth	Seattle	3½	32.4	4500
*Rowe	Lancaster, Pa	4		4500
Perfection	Minneapolis	4½	36.1	4500
White	Cleveland	5	28.9	4500
U S	Cincinnati	5	32.4	4500
Perfection	Minneapolis	5	36.1	4500
Super-Truck	Waukegan, Ill	5	36.1	4500
American	Portland, Ct	5		4500
Old Reliable	Chicago	5	36.1	4500
Sandow	Chicago H'ts, Ill	5	37.5	4500
Kalamazoo	Kalamazoo, Mich	5	40.0	4500
Hurlburt	Harrisburg, Pa	5-5½	32.0	4500
Clydesdale	Clyde, O	5-7	36.1	4500
*Tiffin	Tiffin, O	6-7		4500
Wilson	Detroit	5-7	36.1	4520
Witt Will	Washington, D C	5	45.0	4550
Wisconsin	Madison, Wis	3½	36.1	4600
Pierce Arrow	Buffalo	4	32.4	4600
Schacht	Cincinnati	5	32.4	4600
Moreland	Burbank, Cal	5	36.1	4600
K Z	Chicago	5	36.1	4625
Three Point	New York	6	28.9	4650†
Pierce Arrow	Buffalo	5	32.4	4700
*Traylor	Allentown, Pa.	5		4700
*Hendrickson	Chicago	6		4725
Sterling	Milwaukee	3½	42.1	4750
Denby	Detroit	5	36.1	4750
Gotfredson	Detroit	5	40.0	4775
De Martini	San Francisco	4-5	32.0	4850
*Rowe	Lancaster, Pa	5		4850
D-Olt	Woodhaven, N Y	5	43.0	4890
Ward La France	Elmira, N Y	5 7		4890
Amer La France	Elmira, N Y	3½	28.9	4950
Mack	New York	3½	40.0	4950
Selden	Rochester	5 7	36.1	4950
Atterbury	Buffalo	5-6	36.1	4975
Fageol	Oakland, Cal	3½-4	32.4	5000
Garford	Lima, O	5	40.0	5000
U S	Cincinnati	7	36.1	5000
Doane	San Francisco	3½	31.0	5100
Pierce-Arrow	Buffalo	6	32.4	5100
Rainier	Flushing N Y	6-7	36.1	5100
Maccar	Scranton, Pa.	5	40.0	5200
Pierce Arrow	Buffalo	7½	32.4	5200
Parker	Milwaukee	5	40.0	5250
Master	Chicago	5	36.1	5290
Available	Chicago	5	40.0	5375
Sterling	Milwaukee	5	52.1	5400
Amer La France	Elmira, N Y	5	36.2	5500
Ultimate	Hillside, N J	5	40.0	5500
Mack	New York	5	40.0	5500
Super Truck	Waukegan, Ill	7½	40.0	5500
Fageol	Oakland, Cal	5-6	32.4	5700
Mack	New York	6½	40.0	5750
Sterling	Milwaukee	5	42.1	5750
Doane	San Francisco	6	40.0	6000
Old Reliable	Chicago	7½	36.1	6000
Mack	New York	7½	40.0	6000
MacDonald	San Francisco	5-6	25.0	6300
Sterling	Milwaukee	7½	52.1	6500
MacDonald	San Francisco	7½ 15	32.0	8000

Trucks of the following ratings and S A E horsepower are offered by the manufacturers indicated, under a policy of quoting prices on application only from a prospective purchaser We are therefore unable to list these in their proper places in the table above

Acme Cadillac Mich.
1 (22.5), 1½ (22.5) 2 (22.5) 2 (27.2), 3 (27.2), 3 (32.4), 4½ (36.1), 6 (36.1)

Brockway Cortland, N Y
1 (25.6) 1½ 2 (25.6), 2½ 3 (27.2), 3½-5 (32.4), 5-7 (36.1)

Chicago Chicago
1½ (25.6), 2½ (25.6), 3 (32.4), 3½ (32.4), 5 (32.4)

*Commerce Detroit
¾ 1½ 1½, 2½

*Day Elder Newark N J
1½ 2 2½, 3, 4, 5-6

Diamond T Chicago
¾ 1 (25.6), 1 (22.5), 1½ (22.5), 2½ (25.6), 3½ (28.9) 5 (32.4) 5 (36.0)

Federal Detroit
1 (22.5) 1½ (22.5), 2½ (27.2), 3½-4 (32.4), 5-6 (36.1)

Fulton Farmingdale, N Y
1 1½ (22.5), 2 2½ (22.5)

G M C Pontiac, Mich
1 (19.6), 2 (25.6), 3½ (32.4), 5 (32.4)

Hahn Hamburg, Pa
1 (25.6), 1½ (25.6) 2 (27.2), 2½ (27.2), 3 (32.4), 5 (32.4), 6 (36.1)

Indiana Marion Ind
1 1½ 2, 2, 2½-3, 3½-4, 5 7

International Chicago
1 (19.6), 1½ (22.5) 2 (22.5), 3 (28.9), 5 (28.9)

Kelly Springfield Springfield, O
1½ (24.0), 2½ (24.0), 3½ (32.4), 3½-5 (32.4), 5-7 (32.4)

Menominee Clintonville, Wis.
1 (26.5), 1¼ (26.5), 1½ (26.5), 2 2½ (26.5), 3½ (32.0), 5 (36.0)

Ogden Chicago
1, 1½, 2½, 3½, 5

Republic Alma, Mich
1¼ (22.5), 2 (22.5), 3 (25.6) 3 (27.2), 4½ (32.4)

Sanford Syracuse N Y
1½ 2 (22.4), 2½-3½ (27.2), 3½-5 (32.4), 5-7 (32.4)
Six cylinders ¾ 1½ (27.3), 1½ 2 (27.3)

Service Wabash, Ind
1¼ (22.5), 1½ (25.6), 2 (28.9), 3 (28.9), 4 (32.4) 6 (32.4)

Signal Detroit
1¾ (22.5), 2½ (27.2), 3½ (27.2), 5 (32.4), 7½ (36.1)

Transport Mt Pleasant, Mich
1 (22.5), 1½ (22.5), 2 (25.6) 3½ (28.9), 5 (32.5)

*United Grand Rapids, Mich.
¾, 1½, 2, 2½, 3½

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

GLIDER.—W INKELDER, 58 W 92d St, New York, N Y Among the objects of this invention is to produce a motorless heavier than air machine which is so constructed as to permit of the carrying of an operator and the maintenance of the machine in flight for an appreciable length of time by the utilization of air currents. A further object is to provide manually adjustable wings constituting climbing surfaces and a foot actuated elevation controlling rudder, whereby the operator may readily control the machine after a take-off (See Fig 1)

Pertaining to Apparel

BRASSIERE—I PAKES, c/o Star Brassiere Co, 30 W 15th St, New York, N Y The invention relates to a combined brassiere and camisole, and has for its object to present a construction wherein the garment may be quickly and easily applied or removed by the person using the device A further object is to provide a brassiere having an opening near the front and a plurality of securing members together with a flap for presenting a continuous smooth surface over the fastening members at the front of the garment.

FASTENING DEVICE FOR CUFFS—A L THORNTON Box 559, El Paso Texas. The object of the invention is to provide a fastening device which cannot be accidentally detached from the cuff although adapted to be easily applied to or detached from the cuff by the person using the device The device is simple yet ornamental and attractive in appearance It is also durable and may be easily manufactured

Chemical Processes

CARBURANT FOR ALCOHOL—J M A CHEVALIER, P BOURCET and H REGNAULT c/o J M L Chevalier, 11 Rue de Mademoiselle, Versailles Seine et Oise The invention relates to a process of carburation of alcohol, the object of which is to furnish the alcohol with volatile products rich in carbon and capable of imparting to it a calorific power comparable to that of petroleum benzine The process is characterized by the addition to the alcohol of volatile oil of resin of a mean density of 0 890 and a light oil of acetone

Electrical Devices

REFLECTOR AND LAMP SUPPORT—R S BRADLEY 256 S Bunker Hill Ave Los Angeles, Cal The invention relates to lighting fixtures An object is to provide a support for a reflector and incandescent lamp, which will permit of the lamp and reflector being adjusted to various positions whereby the light from the lamp may be utilized at various angles to best advantage The support is simple in construction, easy to manufacture and very effective in carrying out its purpose (See Fig 2)

CALLING DEVICE—W L WHIDDEN Box 75 Morgan Hill, Cal This invention relates to calling devices for telephone exchanges and is designed principally for small telephone exchanges such as private branch or the 40 drop camp boards used by the United States Government. The object is to substitute for the dry batteries used for ringing or calling an induction coil utilizing its alternating high voltage current for ringing the bell thereby saving from 48 to 60 batteries

MOTOR DRIVEN CIRCUIT CARRIAGE—S H SHARPSTEEN Tenafly, N J The invention relates to electrical distribution and particularly to means for distributing the same through a traveling member to a second traveling member and has for its object to provide a construction wherein the electric current may be supplied in any quantity at a minimum cost over a maximum area By this invention of universal circuit carriage, current may be distributed for railroad use canal navigation, stone quarries lumbering and agricultural purposes with an arrangement whereby the vehicle utilizing the current is permitted movement in any direction

ELECTRIC IRON—J LEWISKY and A HEDTRICH c/o C W Froessel 931 Broadway, Brooklyn, N Y An object of the invention is to provide means whereby an electric iron can be mounted on a stand and when disposed thereon in a particular position will receive heating current, but when disposed in a different position will not receive the heating current A further object is to provide a stand with which electrical mechanism is associated for automatically turning on the current

DRY CELL PRIMARY BATTERY—W S DOE c/o Doe Electrical Device Co Day and Water Sts Kent O Among the objects of the invention is to provide a dry cell primary battery arranged to permit the user to readily replace a used up cell by a new one and to revive the battery, in case its energy is run down by merely adding water to one of the dry-cell elements The battery is particularly serviceable for use in portable flash lamps or hearing devices

THERMOSTATIC SWITCHING DEVICE FOR ELECTRIC IRONS—F JERMIN, c/o N M Eddy Alpena Mich The main object of this invention resides in the provision of a thermostatically operated switch constructed to open and break the electric circuit at a predetermined temperature and means combined therewith to prevent the switch from being closed again until the iron has cooled by a definite amount. Another object resides in constructing the switch in such manner that it may be at any time released manually

HOW MAY A PATENT BE OBTAINED?

ALL proceedings in the Patent Office, the ministerial department of the Government created for the purpose of carrying into effect the right of protection of inventions given by the Constitution are governed by the provisions of the Revised Statutes. Where the latter do not specifically control, the Rules of the Patent Office itself apply To obtain a patent the inventor, or if he is deceased, his executor or administrator, must make application to the Patent Office in the form prescribed The application consists of a petition to the Commissioner of Patents praying for the grant of a patent, a written specification of the invention, an oath regarding the applicant's inventorship, in most cases a drawing, and more rarely the application is accompanied by the deposit of a model or of specimens. The application must also be accompanied by the payment of the Patent Office fee The actual scope of the invention, of which the patent affords a monopoly, is defined by the claims forming part of the specification A patent claim is the definition in words of the actual patentable invention in question It is probably the one most difficult expression in the English language to formulate It must be clear, terse and precise. It must not be too limited and it must not be too broad As a general proposition, the shorter a claim, the broader its scope, for it must be remembered that every patent claim must be considered in its entirety and, therefore, every element or feature included therein is a definite limitation That a patent may disclose far more than is actually patented therein will be readily understood when it is considered that in order to make clear the actual and specific advance in the art involved in the invention, it may be necessary to show it in combination with a great deal more that is already old in that art The progress of an application through the Patent Office, its so-called prosecution before the tribunals of the Office, is often a complicated one The Patent Office Examiner cites as prior art the nearest references in the form of issued patents or other publications, rejecting some or all of the claims originally presented Thereupon the applicant has opportunity to present new claims, to modify those already before the Office, or otherwise to correct and amend the application until finally the applicant and the Examiner are in accord as to the scope of the invention which may be patented As much of this procedure is hedged about with technical considerations, rules and regulations, it is most essential that the application be prosecuted by one thoroughly skilled and experienced

Of Interest to Farmers

METHOD OF AND APPARATUS FOR SUPPLYING WATER TO IRRIGATION DITCHES—C T PETERS Columbus, New Mexico The object of the invention is to provide a method and apparatus of the character described whereby an adequate and uniform supply of water may be had from the water bearing sand of a river bed at all times irrespective of flood or drought a conduit leading to the irrigation ditch to supply the water

MUZZLE—C M RASMUSSEN Box 34 Deschutes Ore An object of the invention is to provide a light weight muzzle with adjustable means for controlling the grazing activity of an animal so that the quantity of grass or other vegetation accessible to the animal varies as required during different seasons and under different conditions so that the animal may be prevented from eating excessive quantities and the consequent bloating The device when in position does not chafe or interfere with the movement of the animal's jaws

HARVESTER FRAME CONSTRUCTION—M D KAST 616 Calvin St Pendleton Ore An object of the invention is to provide a frame construction which permits a proper leveling of the frame regardless of the angle or side hill inclination and which maintains the wheels in a vertical position and the frame relatively low to the ground and at the same distance from the ground at all leveling positions This frame permits of a proper leveling either on flat ground or on the hillsides or inclining surfaces

Of General Interest

ANT TRAP—J W POLLOCK Soldiers Home Sawtelle Cal The invention relates particularly to a trap designed for catching ants an object being to provide a trap of this character from which an insect cannot escape and designed in such a manner that ants or other insects are induced to enter A further object is to provide a trap which will be simple practical easy to clean and inexpensive to manufacture

COMBINED STORM SASH AND WINDOW SCREEN—B F LADUE 802 Duryea St., Raymond, Wash It is the object of this invention to combine with a window screen a storm sash which will prevent rain coming through the screen and thus enable the windows to be always open and screened during a storm It is also an object that the combined sash and screen be adapted to be easily positioned in the runway of the lower window sash (See Fig 3)

STATISTICAL RECORD AND FILING DEVICE—F W WOGLOM 151 Beach St Arlington N J It is the aim of this invention to provide a statistical record and filing system whereby a complete and accurate record of all transactions between a manufacturer and a customer together with the nature of the article etc may be kept It is a further object to provide means by which an entry clerk may keep the record complete and up to date It is not necessary for him to make different entries in different ledgers, the folder comprising record sheets for indexing merchandise bought and sold, summary and recapitulation thus saving a great amount of bookkeeping (See Fig 4)

CLAY SHINGLE BLOCK AND WALL CONSTRUCTION—A HARBOUCOURT Jr 103 Park Ave New York N Y The invention has for its object to provide a building unit of clay preferably formed hollow and also formed as an interlocking block

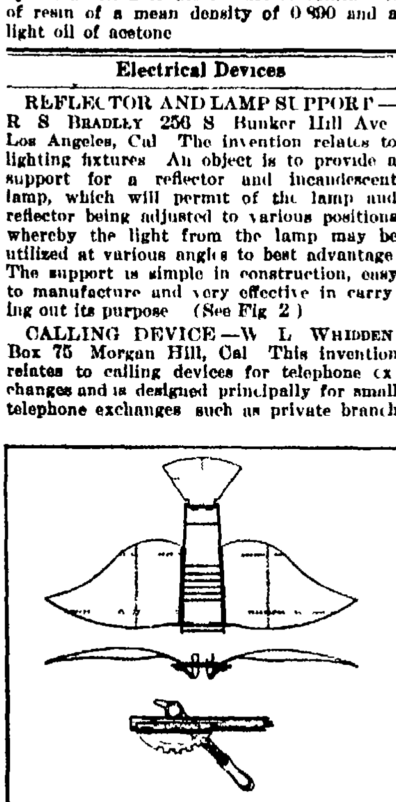


Fig 1 Motorless glider designed and patented by W Inkelder

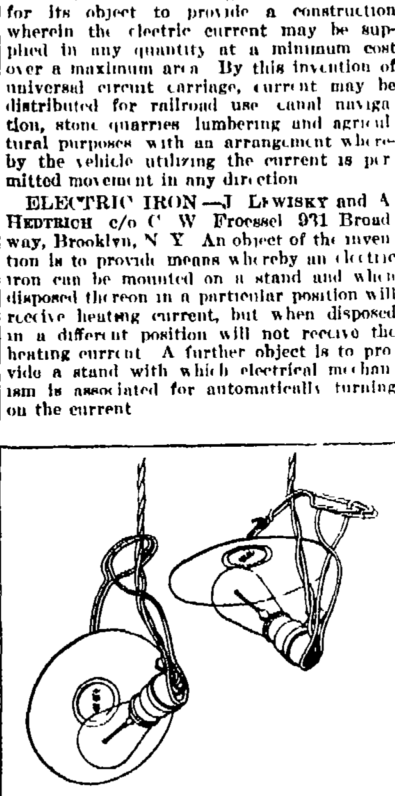


Fig 2 Freely adjustable lamp supporter invented by R. S. Bradley

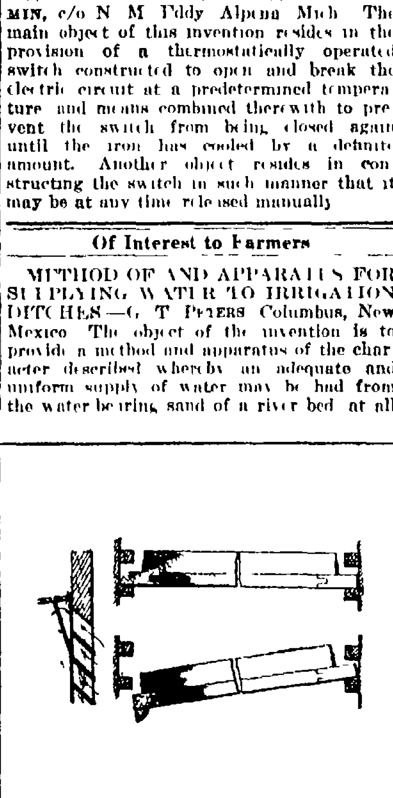


Fig. 3. B. F Ladue's storm sash combined with window screen

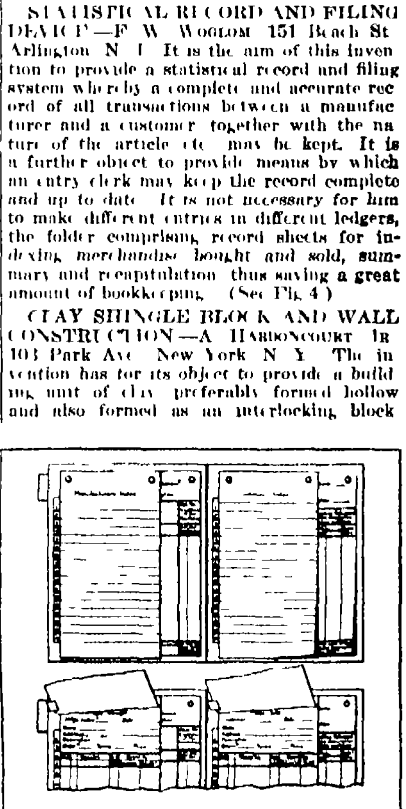


Fig 4 Improved bookkeeping system devised by F W Woglom

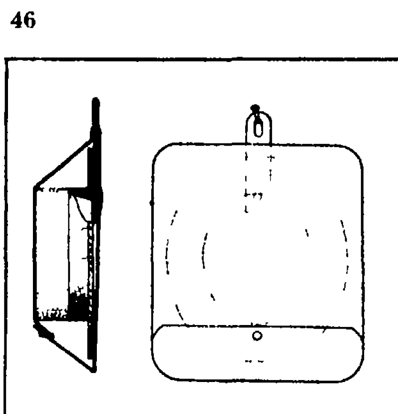


Fig 5 Hat and garment protector patented by J J O'Leary

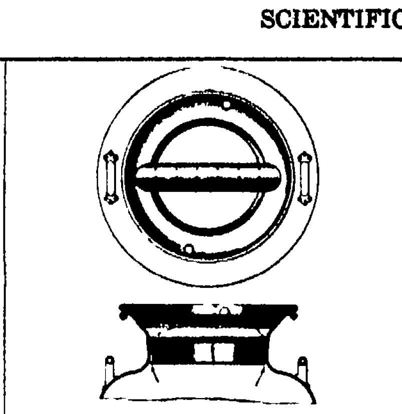


Fig 6. G T Morris' ventilated cover for containers

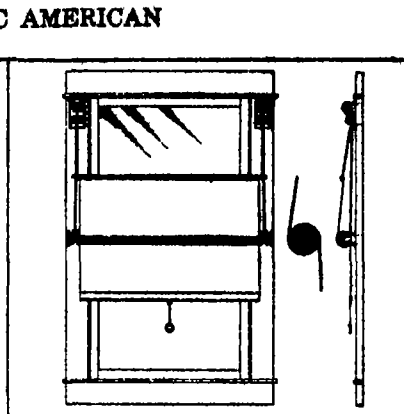


Fig. 7 Novel window-shade assembly invented by W F Church

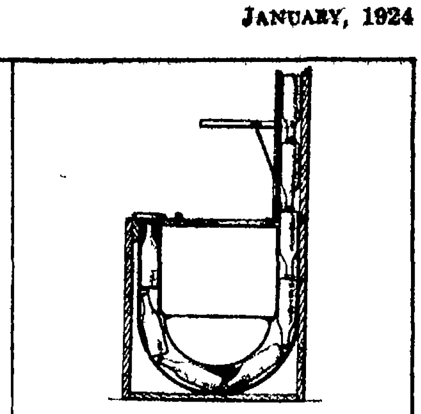


Fig. 8. Dispensing machine for cold bottled beverages, the invention of J H. McKim

producing a wall structure which will simulate in appearance, effect, and waterproofness, the usual type of shingle wall construction the block being of similar size and dimensions to that of the standard shingle wall construction

DETACHABLE HANDLE FOR BROOMS—W H Zachry Humphres St. and Southern Ry, Atlanta Ga The invention has for its object to provide a broom having a detachable handle adapted to be positively and rigidly associated with the broom structure and which is of simple and durable construction easily attached to the broom head and comparatively inexpensive to manufacture

TRAP—H M Britan Ojus Fla The invention relates to a spring trap especially adapted for trapping mice rats and the like An important object is to provide a wide treadle plate which not only acts as an apron to keep the base of the trap clean but also acts as a contact member so that if the rat or mouse stands thereon the trap will be sprung A further object is to provide a bait carrier especially adapted to receive loose grains

RUG AND PROCESS FOR MAKING SAME—R S Mathis 413 Filmore St. Corinth Miss An object of this invention is the provision of a process for forming a rug whereby the rug will be more ornamental more serviceable and more economical to manufacture and whereby the center of the rug will have in effect a continuous flat surface whereby puckering or buckling up will be prevented

CANNING DEVICE—I Rancadore and L Pecoraro 687 Locust St San Jose Calif The invention relates in general to the canning industry and particularly to a device for facilitating the packing of food products such as string beans asparagus or the like which for the purposes of convenience are usually packed in upstanding position with the pieces arranged substantially parallel to one another the device is used as a means of assembling the products before transferring them to the can

GOPHER GUN—R F Armstrong Box 353 La Cygne Kans The invention relates to a gun which is operated by the gopher when the animal is in the line of fire whereby destruction is made certain the gun is positioned so as to be most effective in its purpose Another object is to provide a gun which is simple reliable in operation and inexpensive to manufacture

BAG—D Traum c/o Dritz Traum Co., 27 E 22nd St New York N Y The invention has for its object to provide a ladies handbag or pocket book of a pattern wherein a beaded structure is presented which is very inexpensive but presents a very pleasing appearance A further object is to provide a stamped set of blanks with lines guiding a worker in applying the beads so as to present the appearance of a woven structure

HAIR CURLER—A C Heathcote, 6124 Justine St. Chicago Ill An object of the invention is to provide a hair curler which may be used a multiplicity of times with but little wear thereto A further object is to provide a device by means of which the hair may be curled or waved without the application of heat The device is simple and may be easily applied

SPRAY GUN—L L Tirrell c/o Tirrell Mfg Co Bridgeman Mich Among the objects of this invention is to provide a spray gun for spraying ceilings or the like in which the liquid is thoroughly atomized and subsequently projected through a suitable nozzle A further object is to provide a device in which the atomized liquid may be projected through one or two nozzles by merely turning the central feed tube.

FOUNTAIN BRUSH—J V Huether, 526 59th St., Brooklyn N Y The invention relates to combined containers and applicators for semi liquid or past coating substances such as shoe or stove polishes Among the objects is to provide a brush or dauber which includes means for the accommodation of a supply of polish and means for feeding the same as needed and means for shutting off the feed to prevent waste, and means for replenishing the supply

MEANS FOR OBTAINING SPHERICAL RELIEF IN PICTURES—A E. Bertelson, 171 W 23rd St. New York N Y An object of the invention is to provide a device in which a picture drawn upon a flat surface having two dimensions may be viewed through a transparent plate and given the appearance of a picture having three dimensions the third dimension representing depth concave cylindrical lenses of various powers being employed to produce the result

FASHIONED ANKLE AND ARCH SUPPORT—A Posner 140 Roebling St, Brooklyn N Y The invention has for its object to provide an ankle and arch support more especially designed for inserting in boots or shoes of standard makes and sizes and fashioned to provide an aid to the foot particularly when the wearer is exercising climbing golfing skating or indulging in sports liable to strain the foot the device especially supporting the ankle bone

FOLDING STOCKING STRETCHER.—H A Berendsen Bangor Pa The invention relates to a stocking stretcher which unfolded presents a proper form on which a stocking may be positioned for stretching and drying and when not in use may be folded to a compact body and easily stored The device is simple may be quickly folded and unfolded and may be adjusted to accommodate stockings of different sizes

HANDBAND OR PROTECTOR FOR BASEBALL PLAYERS—E Kobbe c/o Parker Stearns & Co, 300 Sheffield Ave, Brooklyn N Y The invention has for its object the provision of a simple device whereby the hands of a person playing a game such as baseball especially that portion of the hand over the bone joints may be protected from the impact of such an object as a baseball The device comprises a hollow cushioning means of rubber which may be inflated, disposed on a band over one of the joints

WINDOW CLEANING DEVICE—G Hunter 418 Central Park West, New York, N Y An object of the invention is to provide a simple means whereby both of the glass surfaces of a window may be readily cleaned from the inside without requiring the operator to stand upon narrow window ledges or attempt to reach the outside of the glass from within both of which conditions may be difficult and dangerous

STOPPER.—O J Cross 140 Church St., New York N Y It is the purpose of this invention to construct a stopper so as to insure the removal of the stopper by means of a pull on the bottle or container and to permit a certain amount of adjustment of the stopper transversely to insure a tight fit in the neck of the bottle the device is particularly adapted for fire extinguisher containers

STOCK CARD—R H Reed Klamath Falls Oregon An object of the invention is to provide a card having means for indicating the exact quantity of stock on hand, and means to indicate the movement of the stock A further feature is that the stock card indicates the correct location of the stock so that verification may be made at any time by a person not thoroughly acquainted in the stock room

SCALE—M M Munk, 3436 Mt. Pleasant St, N W, Washington, D C One of the foremost objects of this invention is to provide a scale for weighing letters and other small objects. Another object is to provide a cheaply manufactured scale which consists of a few parts stamped out of sheet metal and bent into proper shape, and to provide an arrangement of fulcrums possessing a degree of yieldability which prevent the scales lever from jamming

FLY SWATTER.—H W Mangold and A M. Mangold, 442 So 9th St. San Jose, Calif An important object of the invention is to provide a fly swatter having a handle the forward portion of which is formed with an elongated loop about which a striking element such as a piece of rubber is extended and the striking element is provided with attaching portions secured to the body both inside and exteriorly of the loop whereby a positive connection is provided between the striking element and the loop.

X RAY FILM HOLDER.—A Hallenberg, Fargo N D An object of the invention is to provide a device having means for holding an x ray film in a desired position within the mouth of a patient, and for indicating to the operator the exact position of the film whereby the rays can be so directed that the shadow cast on the film will conform in contour to the selected object which is opaque to the rays.

PLUG—L Stephens 508 3rd St, Marietta Ohio Briefly stated this invention relates to a packing plug preferably formed of a single piece of wood or the like and having a plurality of segmental sections adapted to be moved longitudinally with relation to each other so as to increase the cross sectional area of the plug A further object is to provide a plug which is of highly simplified construction

HAIR IRON—J P Caneavri c/o J E Rose, Atty Box 275, Port Arthur Texas Among the objects of the invention is to provide a device which has a wide range of utility being capable of advantageous use in either crimping or straightening the hair in any desired manner and to any degree, the device is provided with electric heating elements is simple and durable and safe in operation

DYNAMITE PUNCH—R M Fuzzard, 100 So Miami Ave Miami Fla. The invention relates to punchers especially adapted for punching a hole in a stick of dynamite preparatory to inserting a cap in the cartridge. An important object is to provide a punch which will effectively hold a stick of dynamite in position during the operation of the punch so that the hole may be safely and expeditiously formed either in the end or side of the stick.

TRAP—P Strong, Box 308, Oatman, Ariz The particular object of the invention is to provide a self-operating trap comprising an individual cage adapted to trap animals and to deliver them into a larger compartment, returning automatically to its set position The trap once set up needs hardly any attention since it automatically sets itself, its capacity is limited only by size of the confining compartment.

TOOTHPICK—R. E. Lunday, Keystone Hotel San Francisco, Calif An object of the invention is to provide a toothpick of simple construction which is adapted to be readily secured to the tongue of the user, whereby the inner side of the teeth may be cleaned A further object is to provide a device of the character described which is made of a resilient material whereby it will readily conform to the tongue

WALL CONSTRUCTION—J A Lynch, Leonia, N J The invention relates more particularly to a wall construction formed of brick of the ordinary type combined with a special form of building block. One of the primary objects is to construct the wall so that between the inner and outer surfaces there will be provided air spaces for the purpose of eliminating moisture.

KEY CHAIN REEL—T J Morrison, 367 W 123rd St., New York, N Y The general object of the invention is the provision of a compact reel and casing, provided with extensible means for holding a key chain or the like, the device operating to retain the extensible key chain in its extended position for unlocking a door, and in a manner that may be operated to draw the extensible key holding means into the casing, and hold the keys close to the body

HAT PROTECTOR—J J O'Leary, Hiets Lane, Glenside, Pa. This invention has for its object to provide a simple, economical and efficient covering for hats or garments whereby they can be very easily stored away and protected from dust and dirt, the garment being not only stored within the protector, but also firmly supported The protector is so constructed that it may be manufactured at a very low cost. (See Fig 5)

VENTILATING COVER FOR CONTAINERS—G T Morris, c/o Wm. Wayne, Missoula, Mont. The invention relates more particularly to containers employed for transporting milk cream and the like One of the primary objects is to provide a container in which the interior will be at all times in communication with the exterior to afford proper ventilation of the contents It is a further object to so construct the cover for milk containers that the gases generated within the container may be discharged therefrom (See Fig 6.)

WINDOW SHADE—W F Church, Mrs. Mary M Church, executrix, P O Box 1327, Greeley, Colo This invention relates to window shades for curtains of the type including two shades both adapted to be drawn from the same roller in opposite directions when the roller is located at a point intermediate to top and bottom of the window, so that imparting a turning movement to the roller one curtain portion is drawn up and the other is simultaneously drawn down (See Fig 7)

REFRIGERATOR.—J H McKim, Box 766, Mobile, Ala. The invention relates to a dispensing refrigerator for bottled beverages or liquids, and has for its object to provide a device which is of such simple and durable construction as to present a compact and ornamental appearance and yet contain and cool a relatively large number of bottles which may be conveniently dispensed by a simple ejecting mechanism in the form of a spring finger The bottles are exposed to the full effect of the cooling medium and yet protected against breakage or injury (See Fig 8.)

DISPLAY RACK.—G F Breuninger, 763 So 19th St., Newark, N J An object of the invention is to provide a display rack in which the use of spring arms for holding the articles displayed is practically done away with, and a rack which may be conveniently utilized for supporting a number of newspapers or magazines in such a position that the headlines of the papers or names of the magazines are all exposed to view

ARTISTS' FRAME.—E. J Martin, 11 Pratt St, New Rochelle, N Y This invention is particularly designed for use by

mosaic artists. The general object is the provision of an adjustable frame for support ing a flexible paint receiving foundation of dimensions several times that of the cross section of the building or room in which it is desired to work, the device is capable of accommodating various sizes of paint receiv ing foundations.

PUNCTURING ATTACHMENT FOR COLLAPSIBLE TUBES—G S TURNER, 218 Raritan Ave., New Brunswick, N J The general object of the invention is to provide a puncturing attachment to be carried by the tube and held in position by the usual screw cap until required for use, a more specific object being to provide an attach ment of such character as not to detract from the appearance of the tube, and so formed and arranged that it will not con stitute an obstruction in the ordinary han dling of the tube (See Fig 9)

Hardware and Tools

TOOL—F GARRISON, Wendell, Idaho The invention relates in general to tools such as pliers, pincers or the like the object is to provide a tool of this character which embodies foldable handle members whereby the tool, when not in use, may be folded up into a compact article capable of being car ried around in the pocket without discomfort.

LOCK—A YUROW, c/o S M. Elowsky, 346 Crown St, Brooklyn, N Y The prin cipal object of the invention is to provide a lock in which the bolt is effectively pro tected against "jimmying or tampering with either from the outside or inside of the door, both by the keeper and the casing The in vention aims to provide a lock keeper and casing construction which is applicable either to a spring lock or locks of the dead latch type.

WINDOW FASTENER.—A F LAGER STROM 5749 S. Maplewood Ave Chicago, Ill The invention has for its object the provision of a device which will enable the locking of a pair of slidably mounted window sashes A further object is to provide a device which may be secured in an unlocked position, thus obviating the accidental en gagement of the lock in raising or lowering the sash

COMBINATION TOOL—H SCHUETZ, Las Plumas Calif The invention relates to combination tools, the purpose being the provision of a tool which is adaptable to a plurality of uses, and which is of simple con struction, it being placed in compact form when not in use The device is adapted to form a carpenter's square a carpenter's rule a pair of calipers a glass cutting im plement, and may be adapted to hold safety razor blades during the honing or stropping

MEAT HOOK—A W WEYEL c/o J B Gontrum, Atty, 429 New Amsterdam Bldg, Baltimore Md An object of this invention is to provide a hook the individual members of which may be swung inwardly toward each other so that the meat hook can be collapsed and stored when not in use An other object is to provide a hook with radi ating hook members, enabling the hanging of a plurality of carcasses

COMBINATION LOCK—W H JAY, Box 67 Mobridge S D The primary object of this invention is to provide a permutation lock which is practically proof against un warranted manipulation and which is sim ple durable and pleasing in appearance yet strong the arrangement of the parts being such that the lock is adapted to a variety of uses

COMBINED DEPTH AND HEIGHT GAGE.—L J HOGARTY, 150 So Oxford St. Brooklyn, N Y The invention relates to geometrical instruments, and its object is to provide a combined depth and height gage of the micrometer type and arranged to enable the user to readily see and read the distance between opposed contacts to one ten thou sandth of an inch. Another object is to per mit of detaching the micrometer caliper for use as such

VALVE GRINDER.—A LOVELESS 1123 East Market St., Aberdeen, Wash Among the objects of this invention is to provide a valve grinder which is of simple and durable construction, which may be readily applied to the engine whose valves are to be ground and which may be operated without the exer cise of special skill or of laborious effort and to insure proper seating and efficient action of the valve after the grinding operation

AUTOMATIC SHIELD FOR CIRCU LAR SAWS—J E LANTZ 1471 W 73rd St., Chicago, Ill The invention relates to de vices for guarding saw blades to prevent in jury to an operator An object is to provide a device that can be arranged in a desired position with respect to the saw blade and comprises relatively adjustable parts where by it is suitable for use with saws of various sizes, and can be applied to saw or work supporting means of ordinary construction without any extensive changes being re quired

ROUTING HEAD—A MARCEAU, 103 Pineapple St Brooklyn, N Y The object of the invention is to provide a routing head for photo-engraving work and arranged to insure free running of the tool-carrying spindle and reduce wear to a minimum thus prolonging the life of the running parts Another object is to allow convenient and quick assembling and disassembling of the running parts

NUT LOCK—A R JOY MOORE Temple Portland, Ore The main object of the in vention is to provide an absolutely firm and secure lock for a nut, and to prevent the possibilities of its becoming loose by reason of constant jar or exposure to the elements A further object is to provide a washer with a locking lip which constitutes a further or double lock for the nut

TOOL FOR COMPRESSING VALVE SPRINGS—S C HOFF Highway Dept San Antonio, Texas Among the objects of the invention is to provide a tool including a fixed fork and a movable fork adapted to cooperate in compressing a spring and to provide means whereby the movable fork is constantly in parallelism with the fixed fork at all points of travel the devices is simple durable and inexpensive to manufacture

Heating and Lighting

PORTABLE OVEN—I H PAWLICK c/o Enterprise Portable Oven Co 1502 Clybourn Ave Chicago Ill Among the objects of this invention is to provide a port able oven which may be readily disassem bled and packed in a relatively small space for shipment A further object is to pro vide an oven with a plurality of shelves which is adapted to various kinds of heat and which makes use of a novel form of door construction

AUTOMATIC DRAFT REGULATOR—V B CARR and S H BROSHAR, 217 W Chicago Ave Lebanon Ind An object of the invention is to provide an automatic draft regulator for a furnace which is ac tuated by the steam pressure in the boiler A further object is to provide adjustable means for automatically keeping the pres sure of steam in the boiler at a predeter mined point and automatically regulating the opening and closing of the draft door and the check draft

BUCKET—W L THOMPSON, 324 Wern berg Bldg, Greenville, Miss One of the principal objects of the invention is to pro vide an earth working bucket which is par ticularly capable of use as a scraper bucket. Another object is to provide a bucket which will not only be under the complete control of the operator but will also serve to effect ively accumulate the material and retain the same in the bucket while it is being conveyed to the desired points

HEATER—I D STOUT, c/o W H Jackson Co 2 W 47th St New York N Y The invention relates to heaters of the electric type Among the objects is to provide a permanent heater especially adapted to bathrooms and similar localities mounted within a recess in the wall and so constructed that the outer portion is in imitation of an ordinary hot air register the outer face being flush with the wall

Machines and Mechanical Devices

TOBACCO PACKER—O R MATSON c/o R N Nelson 117 W Main St Madison Wis The object of the invention is to provide mechanism for easily and readily compressing or packing tobacco leaves into the desired bales or bundles the device is adapted to operate on all varieties of tobacco is readily controlled and in general is of simple and durable construction

MACHINE FOR SHAPING CYLIN DERS—A VAN A FELTEN 38 Morris St Danbury, Conn The aim of this invention is to provide a device for use in connection with the making of metallic receptacles al though not necessarily limited to this par ticular adaptation An object is to provide a machine by means of which a cylinder may be treated to form a flange or corrugation in the body, means being provided to at all times retain the cylinder in proper position with the operating parts of the machine

FUR SOFTENING AND CLEANING MACHINE—S FRIEDMAN, 48 Lafayette Ave Evergreen Brooklyn N Y The in vention relates to furs and pelts its object is to provide a machine for softening and cleaning fur garments and fur skins in a quick and effective manner without danger of injury to the garment or skin A further object is to facilitate the placing of the gar ment or skin into the machine and the re moval of the same therefrom and the separat ing of the cleaning medium from the gar ment or skin

HOLLOW STEM SUCTION VALVE—P R ROTHE 915 N Waller St Chicago Ill An object of the invention is to pro vide a form of valve designed particularly for use in the inlet of apparatus for compressing elastic fluids such as air oxygen nitrogen ammonia or other gases to a pressure up to 3 000 pounds A further object is to pro vide a device constructed to remain closed when the elastic fluid is being compressed and consequently permit no return of the gas through the inlet port

POSITIONING MEANS FOR PISTONS—I R DAVIS and R M HUGHES 600 Turk St San Francisco Calif The particular object of the invention is to provide means for positioning the internal studs of a piston so as to aline the same with a drill guide for the purpose of boring a hole through the studs adapted to receive the wrist pin to which the connecting rod is attached The device will accomplish the object with little loss of time and with machine like accuracy

CLAMSHELL BUCKET OPERATING MECHANISM—S O NAFZIGER c/o American Mfg & Eng Co Goshen Ind An object of the invention is to provide a light clamshell bucket which has means for posi tively holding it rigidly while the two halves are being closed in the act of digging A further object is to provide means to steady the bucket while it is being raised or lowered and to provide a track runway construction on which the operating mechanism is carried

GLASS FINISHING AND POLISHING MACHINE—G C SCOTT Watson W Va The invention relates generally to a machine for smoothing the edges of pressed glassware in the nature of drinking glasses or tumblers as well as polishing the external surface thereof the object being the provision of a continuously operating machine capable of movement under manual or mechanical power and of ready adjustment

RINSE TUB—P O VANATTER Athens Ga Among the objects of the invention is to provide a rinse tub having rotary mount ing and divided into communicating compart ments extending to the center of the tub so that the tub may be turned to present any compartment to a station desired either for the operator or a heater or for a drain (See Fig 10)

FLESHING MACHINE—S FRIEDMAN 48 Lafayette Ave Evergreen Brooklyn N Y This invention relates to a machine for cutting the flesh from skins and more par ticularly to a machine in which the revolving knife has the general form of a disk in which high grade steel is employed in the manufac ture More specifically the invention has in view a knife that may be ground with facility and that will enable the cutting edge to be preserved by a whetstone

MECHANICAL RACING COURSE—C LANCLUME and F J YBARZABAL New Orleans La An important object of this invention is to provide an amusement device wherein a plurality of continuous rows of mechanical horses are caused to travel in a given course to represent a horse race A further object is to provide means whereby the horses or figures are supported for move ment in such manner that tipping over of the figures is prevented

UNIVERSAL CUTTING AND KNEAD ING MACHINE—L NEGRO 2 Strada Smardan Bucharest Roumania The inven tion has for its object to provide a uni versal cutting and kneading machine for materials of any kind it substantially com prises two main parts viz two continuous acting cutting and kneading cylinders on the one hand and a metal support or frame con taining the material on the other hand

Pertaining to Vehicles

BOW PROTECTOR FOR AUTOMO BILE TOPS—F H MURPHY I S ISBELL and L W SAWYER c/o Elmer W Sawyer Atty North Anson Me Among the objects of the invention is to provide a safety de vice in the form of a cushion protecting means for the bow of a top of an automobile whereby to avoid possible injury should an occupant of the rear seat be thrown upwardly and strike his head upon the bow The device comprises a casing which may be inflated, and is adapted to be fitted upon the lower side of the bridge portion of the bow (See Fig 11)

RESILIENT WHEEL—J SCHMIDT 620 Ninth Ave, New York N Y One of the primary objects of the invention is to pro vide a wheel of the resilient type in which the resiliency is produced by a plurality of springs A further object is to provide a wheel in which a cushion tire may be em ployed with the result that resiliency equiv alent to that obtained in a pneumatic tire is attained The device may be readily disas sembled for the purpose of repair or the like (See Fig 12)

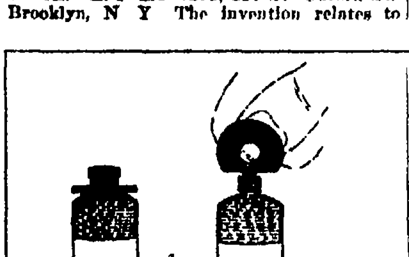


Fig. 9. G. S. Turner shows a new way to get the contents of a container tube

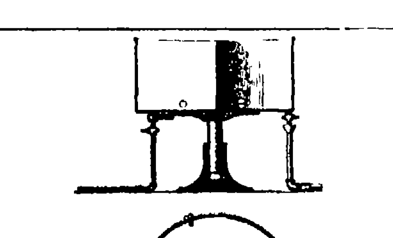


Fig. 10. Rotating partitioned rinse-tub invented by P O. Vanatter

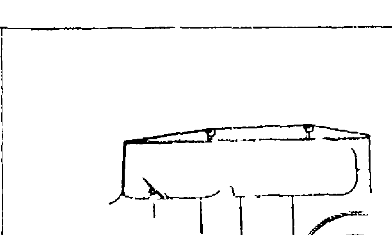


Fig. 11 Invention of E. W Sawyer and others for protecting the automobile top bow from injury by the riders heads

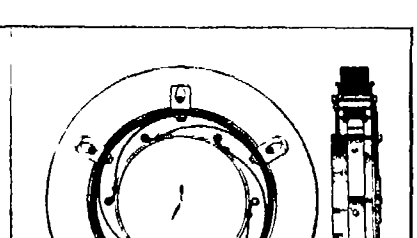


Fig 12 Resilient wheel to permit the substitution of cushion tire for pneumatic patented by J Schmidt

RADIATOR HOLDER.—J W KAGER, c/o Levinski & Levinski Butte Mont. The invention relates to means for holding a radiator in the manufacture or repair of the same and has for its object to provide means whereby the radiator may be turned in its own plane or rocked vertically whereby to dispose the radiator in various angular positions to make all points readily accessible

VEHICLE SPRING —W E STANFORD Taylorville Calif The general object of the invention is to provide a spring assemblage of leaf springs and appurtenances to afford the maximum resiliency and to constitute effective shock absorbers without the necessity of employing shock absorbers additional to the springs The assemblage includes upper and lower curved springs

AIR RELEASE DEVICE —W A E. MADDOCK c/o M E. Church, Milton, N D Briefly stated the important object of this invention is to provide an air release device having simple means whereby the same may be readily attached to a valve stem for unseating the valve, and thereby permit air to escape from the tire The device is of simple construction and is durable in use

LUBRICATING DEVICE — E R BALES 1432 E 65th St. Chicago Ill This invention relates to a device for lubricating the air cylinders of a two stage air compressor and is primarily designed for use with air compressors used on locomotives The object is to provide a lubricator that may be fed from some convenient place and having a restricted feed opening which checks the flow of oil preventing an over supply

TIRE-CHAIN TIGHTENER AND LOCK—L SLAMA c/o Slama Auto Co, Humboldt, Neb Among the objects of the invention is to provide a chain tightener and lock which comprises two members pivotally secured and which are adapted to be locked in closed position by means of a spring pressed pin which takes the place of the usual cotter pin and which securely locks together the two members of the device

SHIELD —A C SANDERS, Helena, Ark The object of the invention is to provide combined ventilating and sun shield for automobiles, adapted to be mounted or attached to any standard type of car and to permit free passage of air therethrough at the same time protect the driver from sun glare also to prevent insects or other foreign elements in the atmosphere from passing through

RADIATOR THERMOSTAT—A I KAPLON, Brunswick Md This invention has for its object to provide a radiator thermostat including an incandescent lamp arranged to be lighted upon completion of the electric circuit when the mercury in the tube reaches a predetermined high or dangerous point, indicating excessive heating of the engine so that the operator of the engine is warned in time

AUTOMOBILE FENDER —S G FITZ SIMONS Charleston S C An important object of the invention is to provide an automobile fender which is rigidly and securely held in its open or operative position subsequent to striking a person and more specifically to provide simple means whereby the sides will be prevented from sagging when open The device is neat in appearance and may be cheaply manufactured

AUTOMOBILE BRAKE—G PARSON 309 1 4th St Plainfield N J The invention relates to a brake for motor driven vehicles the brake having brake shoes movable into and out of braking contact with the transmission shaft The device includes a shaft a block surrounding the shaft a pair of brake shoes pivotally mounted at one of their ends to the block and moving toward or from the shaft on the pivoted ends.

SPRING MOUNTING —V W PAGE c/o Victor Page Motor Corp Melrose Ave, Stamford Conn The primary object of the invention is to provide means for connecting vehicle springs, particularly of the so called cantilever type to the several points of attachments at the ends A further object is to provide a novel form of center bearing and attaching means whereby the lubrication of the spring is greatly facilitated

BELTING — G E PERRY Lincoln Maine The invention relates more particularly to link belting, an object being to provide an arrangement of flexible links such as leather or the like, in combination with coupling pins which permit an easy removal or replacement of worn or injured links without the employment of tools or the necessity of proceeding to a garage or repair shop

EYESHIELD ATTACHMENT FOR MOTOR VEHICLES — J W PRIMROSE, c/o Mrs S W Harlison, 112 N Hinds, Greenville, Miss The object of this invention is to provide an adjustable eye shield for drivers of motor vehicles which may be positioned immediately forward of the driver and at the rear of the windshield associated with the vehicle, and thereby efficiently protect the driver's eyes from the sun glare or the lights of oncoming vehicles.

SPRING WHEEL —G W WATTS 526 N Penn St. Indianapolis, Ind The invention relates to a spring wheel especially adapted for use with trucks although it may be used with motor vehicles generally, as well as other vehicles The object is to provide a spring in which the springs are so organized with each other and with the other elements of the wheel that all the springs are active to support the load and to absorb shocks

COLLAPSIBLE HOOD OR ROOF OF VEHICLES —G BAEHR, 2 Rue des Sablons, Paris, France The invention relates to a device for mounting glazed frames intended for use in conjunction with motor cars and permitting of readily bringing the frames into either the inoperative or operative position without it being necessary to support manually the whole weight of the frame

STRAINER —J H. CRABY, Flushing, N Y The invention particularly relates to a strainer of the type commonly employed for preventing the entrance of dirt into the carburetor of an automobile The primary object is to provide a strainer, which may be cleaned without being taken apart. A further object is to provide a strainer which is durable efficient simple and inexpensive to manufacture

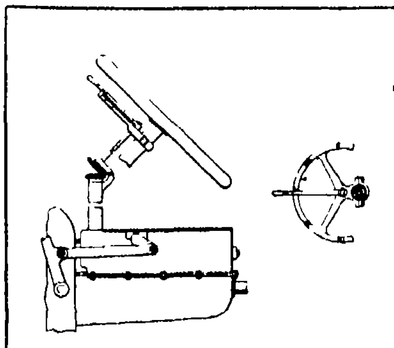


Fig 13 Automobile transmission of the constant mesh type designed by W S. Cunningham

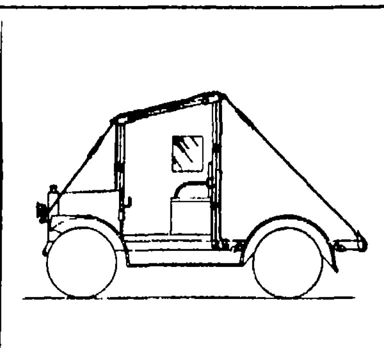


Fig 14 Portable cab for trucks, the invention of E. D Blackinton and G E. Smith

AIR PUMP — E WITMAN, Sinking Spring, Pa The general object of this invention is to provide a tire pump that will efficiently function as a double-acting pump to effect discharge of air with each forward and return stroke of the piston A special object is to provide a device of strength and simplicity

SAFETY DEVICE FOR INFLATING PNEUMATIC TIRES —H H BREEDEN, Millville N J The principal object of the invention is the provision of automatic means for the prevention of over inflation and bursting of a tire when under the process of inflation a further object being to provide a device which constitutes means for gauging the air supply whereby it may be compressed within the tire under a predetermined degree of pressure.

RESILIENT WHEEL —M J DUFFY, 93 Butler St Brooklyn N Y Among the objects of the invention is to provide a wheel employing springs by means of which a conventional solid rubber tire may be used to advantage A further object is the construction of a resilient wheel in which the parts will at all times be accessible for inspection adjustment and oiling

BRAKE IRON —S L HALL, c/o Grant Connally 201 E Main St, Cushing Okla. The invention relates to brake irons for use in connection with wagons although not limited to this use, an object being to provide an iron which is strong and rigid which can be readily secured to the brake beam and which supports the brake shoe so that the latter may be adjusted when worn The iron may be cast in a single piece.

LUBRICATING DEVICE FOR AUTOMOBILES ETC —R B HANSCOM 133 N 10th St. Klamath Falls, Oregon The chief object of this invention is to provide a conduit which is adapted to be installed in the crank case of an automobile for conducting a lubricating liquid from a reservoir to the lubricant receptacles in the crank case. A further object is to provide a conduit that has no inward projecting portions which would tend to interfere with the flow of the liquid.

FLOOR PLATE.—J. E. ERSKINE, 920 Main St., Jacksonville, Fla. This invention relates to a plate adapted to be attached to the running board of an automobile. An object is to provide a relatively simple device that will enhance the appearance of the running board A further object is to provide a plate which embodies a foot scraper, whereby dirt scraped from the foot may fall to the ground without being deposited on the running board.

CLUTCH LOCK FOR MOTOR VEHICLES —L A CALAME, 718 W Ringold St., Freeport, Ill Among the objects of the invention is to provide a clutch lock in which means is provided for positively locking the transmission clutch in a position to disconnect the motor from the transmission mechanism and to provide a device which may be easily attached to the standard types of motor vehicles, the device being concealed from view, with the exception of the foot plunger and adjacent spring lock

RESILIENT WHEEL —C E. WIGGINS, Delhi La The object of this invention is to provide a resilient wheel which is well adapted for use on automobiles or other vehicles and wherein a high degree of resiliency is obtained so as to give the vehicle easy riding properties for use as a passenger vehicle and relieving the running gear and other parts of strains and shocks and rendering the employment of a pneumatic tire unnecessary

INTERNAL BRAKE —V W PAGE, c/o Victor W Page, Melrose Ave, Stamford Conn This invention relates to vertical brakes of the internal type expanded by means of a cam The primary object is to provide adjustable surfaces for the cam to engage in order that the throw of the shoes may be restored to normal when the wearing surfaces have become worn A further object is to provide means for securing the brake lining or friction surface to the shoes

TOP FOR VEHICLE BODIES —C P POND, c/o George L Traffarn Camden, N Y The general object of the invention is to provide a top adapted to be mounted on a vehicle body to comprise a roof together with panels hinged to fold for sustaining the roof in a raised position for making the vehicle body more available for living purposes and to cause the roof to be lowered onto the vehicle for traveling or entering a garage

AUTOMOBILE MIRROR BRACKET AND JOINT —S FEINBERG, 363 Canal St., New York, N Y The invention relates to a bracket and universal joint, and has for its object the provision of means whereby a mirror in its various adjustable positions is more advantageously disposed at all times with respect to a bracket whereby the mirror can be more easily manipulated, the number of parts being small the cost of manufacture is considerably reduced

SHOCK ABSORBER.—D B D BLAKE, 400 Jersey St. Quincy Ill An object of the invention is to provide means whereby quick and simple adjustment of the parts of the device may be achieved, and means whereby the tension of the spring used can be quickly adjusted independently of other adjustments

WHEEL AND TIRE CONSTRUCTION E H ACKERMAN, 70 No Willow St. Montclair, N J The invention provides as a feature a plurality of expansible tube sections each of which carries its own individual inflating valve and which is adapted to be arranged with a plurality of its fellows to completely fill the shoe and to be nested therein in direct end to end contact, one of the important features being the entire elimination of any transverse partitions for separating the different containers.

GREASE RETAINER.—S. R. MORDEN 3174 Washington St., San Francisco, Calif The invention is particularly designed for use on the rear axle of a Ford automobile although not confined to that type of machine. The principal object is to prevent grease introduced into the different housings from working outwardly along the rear axle into the brake drum The device is easily installed, and returns the grease without injuring the axle or axle housing

COMBINED PARKING BUMPER AND THEFT INDICATOR.—L. W NOBLES, 551 W 169th St., New York, N Y An object of the invention is to provide an auxiliary bumper to be employed in connection with the main bumper, and projecting from the front and rear of the car, for preventing drivers from parking their cars too close the bumper also serves as a theft indicator when the car is driven with the bumper locked in projected relation from the opposite ends of the car

SHOCK ABSORBER.—R. RAGSDALE, 130 South Main St, Porterville, Calif The invention is adapted to be used principally in connection with so-called cantilever springs It is an object to interpose a shock absorbing means between the axle and the body of the vehicle which will cause any shock transmitted to the spring from either of the axles to actuate the spring from opposite directions and to thus spend its force in a number of minor vibrations without substantially affecting the body itself

AUTOMOBILE TIRE-CASING TRIMMING AND LINING MACHINE.—F C MOORE, 302 Broad Ave, Canton, Ohio The foremost object of the invention is to provide a machine by means of which certain fin like rubber portions left on the tire casing in curing can be removed and a special preparation applied to the inside of the casing in one operation A further object is to provide for trimming and lining an automobile tire casing certain actions, as for example stopping the rotation of the tire casing and the spraying of the lining fluid being accomplished semi automatically

FLAT TIRE ALARM —M. J BARRY 167 Washington St. Newark, N J Among the objects of the invention is to produce a simple and inexpensive flat tire alarm which is readily applicable to the wheel and tire without necessitating material alteration thereto and which operates to effectively signal the driver of the vehicle when the tire becomes flat or deflated to such an extent that further running will prove injurious to the tire

TRANSMISSION — W S CUNNINGHAM 2027 Elizabeth St., Shreveport, La The invention contemplates a variable speed transmission which includes constantly meshing speed gears together with means for selectively rendering the same operative whereby to eliminate the necessity of shifting the gears into engagement and the resultant disadvantages incident thereto A further object is to provide a variable transmission including speed selecting means, mounted on the steering column within convenient reach of the operator (See Fig. 13)

PORTABLE CAB —E. D BLACKINTON, and G E SMITH, address E D Blackinton, Groton, Conn The general object of this invention is to provide a portable cab attachment to be conveniently used on trucks, tractors or motor vehicles and is particularly adapted for use on a chassis, when not in use the device may be conveniently knocked down in small compass for storage or transportation (See Fig 14)

Designs

DESIGN FOR A TOY ANIMAL.—ELIZABETH A. TICHLER, 14 18th Ave., Paterson, N J

DESIGN FOR A DOLL.—G R. ZIMMERMAN, 42 Clifton Place, Brooklyn, N Y

DESIGN FOR A LIGHTING FIXTURE ARM—A MILLER, c/o Radiant Lighting Fixture Co., 33 Bleecker St., New York, N Y This inventor has been granted two patents for ornamental lighting fixtures.

DESIGN FOR A DOLL.—C. E. GIBSON, c/o Moore & Gibson, 48 E. 21st St., New York, N Y

Electrical Devices

SWITCH FOR ELECTRIC IRONS.—H BENVIE, 909 Broad St. Meriden, Conn An object of this invention resides in the provision of a simple, efficient, and durable electric-iron switch which will operate to open the electric circuit of the line whenever the operator has to leave the iron A further object resides in the provision of means whereby under certain conditions, if the switch cannot be worked, a fusible element will blow to cause the operation of the switch (See Fig 15.)

Hardware and Tools

SCISSORS SHARPENER.—EMILY JONES, 8 E. 72nd St., New York N Y The general object of the invention is to provide a simple and durable scissors sharpener, cast from glass, which presents a neat and attractive appearance, and is of such a size that it may be carried in work boxes or the like. A further object is the provision of a sharpener adapted for use with all sizes of scissors, and that may be operated by people having little mechanical skill (See Fig 16)

TURNING TOOL—W F RONEY 2210 Lowell Blvd, Denver, Colo The object of the invention is to provide a turning tool which is adjustable so as to be readily adapted for use with work on bearings of various sizes and which is so constructed and organized as to accurately turn or true the bearing to its circular cross section irrespective of the adjustment of the turning tool The tool may be readily applied to or removed from the work.

FAUCET—G PFLEGER, 3003 Zephyr Ave, Corliss Pa The object of the invention is to provide a faucet which is adapted to eliminate any possible waste of water or other liquid due to the leak or tight closing A further object is to provide a faucet having a spring pressed valve adapted to be normally closed and to associate with the valve a suitable lever for lifting the same, and means whereby the valve may be locked in raised position

LIFTING JACK—W J MELCHIOR 309 Equity Bldg, Fargo, N D This invention has for its object to provide a jack which is portable and particularly adapted for raising vehicles or the like in a quick and positive manner It is also an important object that the lifting distance of the jack be considerably greater than that possible with the usual portable jack now commonly employed.

Heating and Lighting

HEATING SYSTEM—W A COLLVER, 240 Hall Ave, Marshfield, Oregon This invention relates to a heater associated with an open fireplace and includes a hot air heater, trash burner distinctive smokestack elements, stack cleaning means means to raise and lower the door to or from the fireplace, a water-circulating heating circuit, a water heating door, a range boiler, and means establishing communication between the heater door and boiler (See Fig 17)

PORTABLE STOVE—C O SHELDON, c/o Donna Irrigation District, Donna Texas The general object of the invention is to provide an oil stove adapted for outdoor use for supplying heat in orchards to prevent fruit from being damaged by frost, or for similar purposes The device is durable in construction, economical in operation and inexpensive to manufacture

BURNER—F M DALLEN, 3746 W Pine Blvd, St. Louis Mo The invention more particularly relates to that type of burner which utilizes a fluid as a fuel An object is to provide a device which has means for providing a steady feed of fuel to the combustion chamber and which is adapted to change a liquid fuel into a combustible gas before the latter is burned A further object is to provide a device in which the fuel is first vaporized and then mixed with the desired quantity of air before being conveyed to the combustion chamber

GAS HEATER—A T BROCH P O Box 425 City Hall Station New York N Y An object of this invention is to provide a simple one piece fixture including a burner chamber and a mixing chamber with a connecting conduit suitably dimensioned to provide for a generous supply and flow of gas A further object is to provide a mixing chamber so constructed that there will be no leakage of gas even at low pressure and a burning chamber in which the heat will be effectively radiated

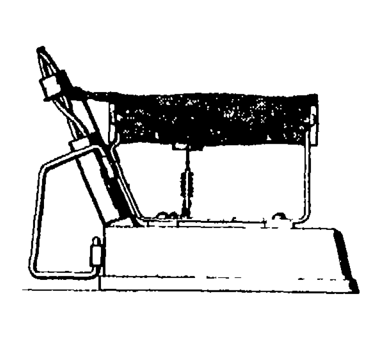


Fig 15 H Benvie's electric iron switch designed to open the circuit whenever the iron is left unattended

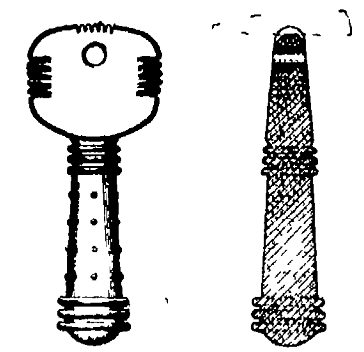


Fig 16 Cast glass scissors sharpener invented by Emily Jones

Pertaining to Vehicles

TRACTOR TRAILER—W C NABORS Mansfield La The primary object of the invention is to provide an arrangement whereby in a train of any desired number of trailers used in connection with an automobile truck or any type of led vehicle each of the several trailers will track in the exact path of the preceding trailers by virtue of the special connections between the wheel turning levers and the wheel shifting tie rods as well as the particular connections between the body springs and the axles (See Fig 18)

BLOW OUT BOOT FOR PNEUMATIC TIRES—L D SHILLING 511 4th Ave East Kalispell Mont Among the objects is to provide a blow out boot which is adapted to be quickly and easily applied to the inner tube of a pneumatic tire which is adapted to remain in position after the tire is inflated and may be removed from the inner tube without danger either to the tube or the casing The construction of the boot is of such a nature that it may be used repeatedly (See Fig 19)

ENGINE CONTROLLED CLUTCH RELEASING MEANS—R I BELCIA Hull Texas The invention relates to the gear control of automobiles and motor cars the object being the provision of means by which to dispense with the manual depression of clutch pedals so as to avoid the nervous strain attendant upon gear shifting or stopping the car In carrying out the invention the suction of the engine is used for the purpose of holding the clutch in released position when the engine is in movement as long only as the accelerator pedal is in retracted position (See Fig 20)

VALVE—W F DURYEA Hackensack N J The invention has for its object to provide a valve in which means is provided for holding the valve stem against turning so that the valve will always seat in the same place to provide means for adjusting the valve and to provide a novel form of locking means for retaining the valve in slightly closed position

CHOCK BLOCK G H LANE 392 Perry St Pontiac Mich An object of the invention is to provide a device of the character mentioned which is constructed of one piece of stock thus eliminating the necessity of separate the pieces such as must be used where two separate blocks are employed A further object is to provide a device which cannot tip up when the load is placed thereon

MUFFLER—F J HERDIE 1847 W Huron St Chicago Ill The invention relates to exhaust muffler for motor cars An object is to provide a muffler in which there are means for reducing the back pressure upon products of combustion or exhaust gases A further object is to provide a device having means for reducing noises occasioned by the rush of exhaust gases therethrough

NON PNEUMATIC TIRE—C A FISK, 656 So Boulevard Bronx N Y The invention has particular reference to a filler for a tire shoe or casing Its object is to provide a form of connection between the outer band of the filler element and the rim of the wheel which more efficiently functions to allow for the local compressions of the tire when encountering an obstacle or supporting the weight of the vehicle

SIGNAL FOR VEHICLES W T COMBS c/o W I McKone Gladstone Hotel 62nd St and Kenwood Chicago Ill Among the objects of the invention is to provide a signal for automobiles which is very simple in construction and which has means for telling the driver of an approaching vehicle the direction in which the vehicle to which the device is attached is going The device may be readily secured to the fender of a car It consists of a minimum number of parts and will not easily get out of order

END GATE—T L LILLY Lacon Ill The invention relates to end gates and fastening means therefor associated with a wagon body or auto truck The invention embodies a combination flat and swinging eye bolt, thus obviating the necessity of employing wagon rods or chain connecting the opposed sides of the wagon box which cannot be drawn out in close quarters, while the eye bolts as provided by the patent may be opened in a minimum of space

SEAT—R M MONTGOMERY 1211 W Kearsley Flint Mich The object of the invention is to provide a seat for vehicles in which all shocks may be absorbed and thus at all times insure the comfort of the occupant. The back of the seat is spring supported and adapted for free vertical movement The seat is also supported by springs to further absorb the shocks to which it may be subjected Roller means are also carried to hold the structure against forward tilting movement

WHEEL FOR AUTOMOBILES—S KAPLAN Monroe La This inventor has been granted two patents of a similar nature Their objects are to provide a wheel of the type including a demountable rim which is susceptible of ready and economical manufacture the parts being in the main formed by stamping pressing or similar mechanical processes Another object is to provide a wheel wherein the demountable rim is easily assembled and disassembled while being securely though releasably locked the organization being such that a single manipulation serves both to release the locking means and to release the rim from its engagement with the wheel

OUTSIDE BRAKE—F J ANDEL, 3720 E 52nd St., Cleveland, Ohio An object of the invention is to provide a brake operating mechanism which may be readily attached to a car of a certain type without altering the construction in the slightest A further object is to provide a construction of outside brake which insures a quick response to the action of the brake pedal and which brings the car to a stop smoothly and without vibration or rattle

SPRING WHEEL—F PALOMBO Stop 7, Bedford Ohio Among the objects of this invention is to provide a spring wheel having a series of bow springs interposed between the inner and outer members of the wheel, said springs having fixed relation to one member and at their ends having movable or rolling engagement with the other member whereby the springs can take varying positions in accordance with the strains or stresses put thereon

TIRE CHAIN HOOK—A FALSTRAUIT, 141 Warner Ave Jersey City N J The invention relates to anti skid tire chains and has particular reference to a hook which connects the cross chains to the side chains An object is to provide an attachment for the usual form of hook of this character, which converts the hook into a snaphook and which is readily applicable to or removable from the end link of the cross chain

SNOW REMOVING APPARATUS—P DUNWALD, Rio N Y It is the object of this invention to provide an apparatus which may be used with an ordinary motor truck and to provide means for attaching the apparatus to the truck A further object is to provide a snow removing apparatus wherein an intense heat is applied to the snow while it is in a flaky condition so that it is picked up and melted at the same time

TIRE—D S KENNEDY 457 E 167th St Bronx N Y The general object of the invention is to produce a solid tire having increased resiliency while preserving strength and durability and to carry out the invention in a manner to provide a non skid member on the tread the tread having undercut recesses alternately at the opposite sides so that the tire radially inward of the tread presents a sinuous form

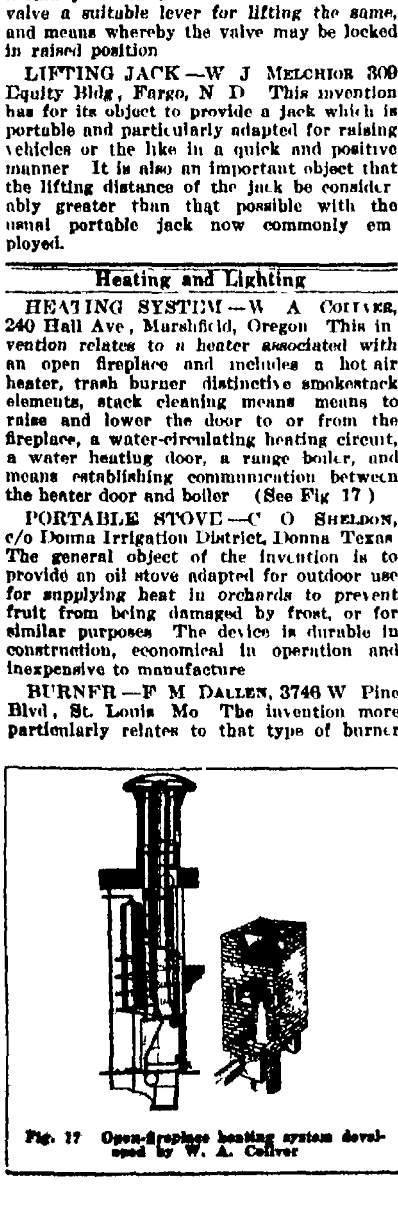


Fig. 17 Open-fireplace heating system developed by W. A. Collver

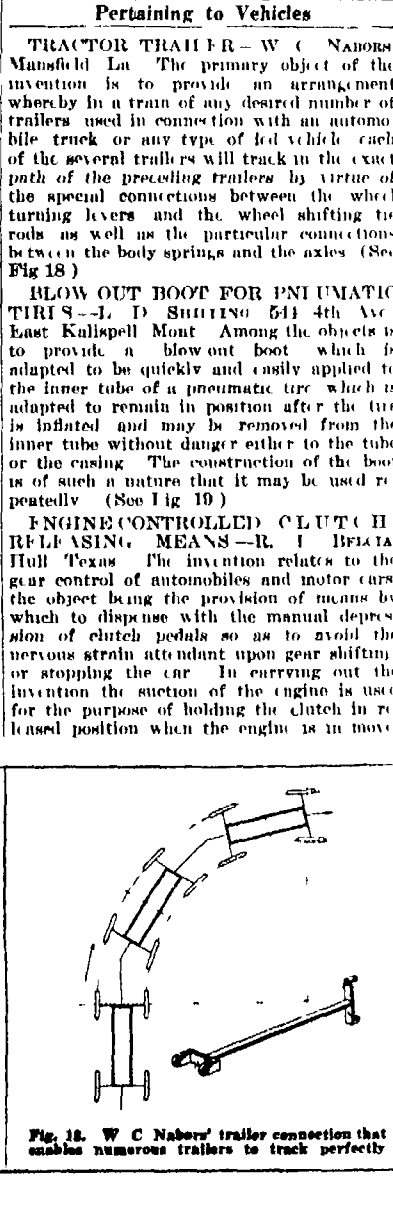


Fig. 18. W C Nabors' trailer connection that enables numerous trailers to track perfectly

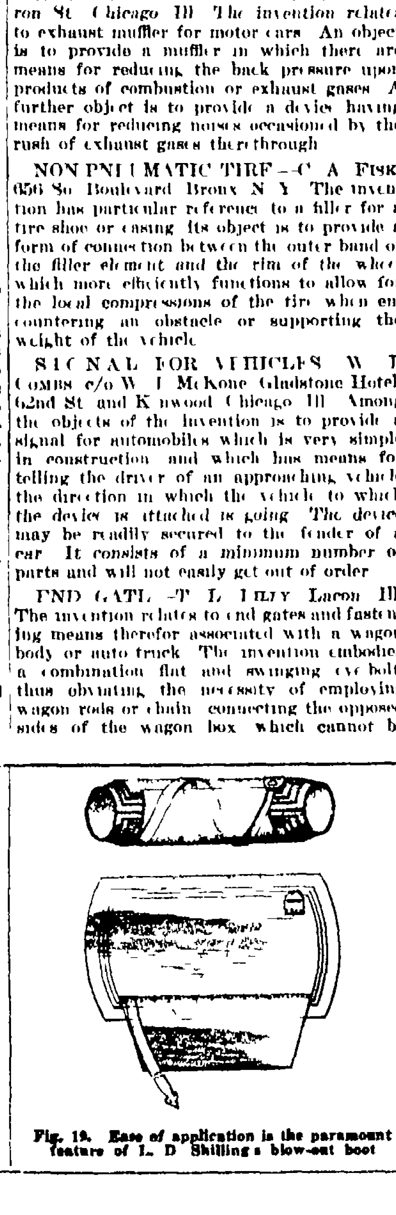


Fig. 19. Ease of application is the paramount feature of L. D Shilling's blow-out boot

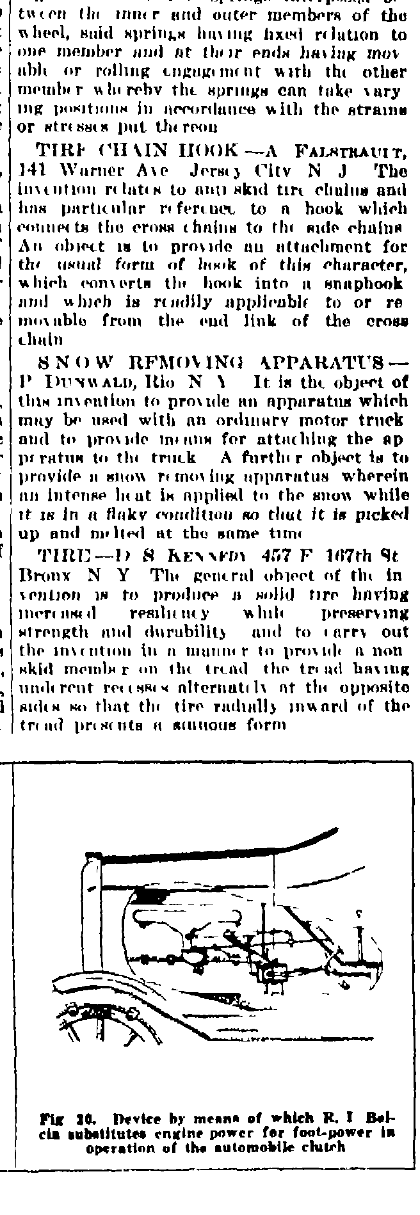


Fig 20. Device by means of which R. I Belcia substitutes engine power for foot-power in operation of the automobile clutch

The Timken Roller Bearing Company~Like

Historical Material by Courtesy Motor Age

The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that these who wish for further data may refer to the originals Other digests ordinarily appear in Electrical Notes, Service of the Chemist, and other departments which are omitted from this issue

Automotive

The Berlin Automobile Show was limited to German manufacturers of whom eighty exhibited cars More cars were shown than at any previous show and a great many new designs were on view In Germany the use of front wheel brakes is gaining steadily and at present about one-sixth of all cars are either regularly equipped with them or can be furnished with them at the buyers option Two good examples of front wheel brakes are the Audi and Dux. Both types are completely inclosed, have inclined steering pivots, facilitating the steering and are operated by cable and rods A special brake equalizer is provided so that the left front and right rear wheel are always applied equally, as well as the right front and left rear The standard braking system still consists of a pedal operated transmission brake and a lever operated rear wheel brake One-fourth of all cars have both brakes acting on the rear wheels Wire cable is used on about one sixth of the models.—*Automotive Ind.*, 49 16, pp 773 78

Civil Engineering

A Hydro Electric Power Plant of 12,000 horsepower, operating under a head of practically one mile (1 650 meters), and having a single penstock of less than two feet diameter, was recently constructed and successfully put in operation in Switzerland The water utilized in this development is drawn from the little lake of Fully which is located in the westerly part of the Swiss Alps at an altitude of about 7 000 feet above sea level The lake is tapped by a tunnel and pipe line about 100 feet below normal water level The penstock extends from the intake at the lake bottom for a distance of approximately three miles down to the valley of the Rhone River The useful storage above the intake tunnel is 2 600 acre feet. Due to the high head this represents a stored energy of 10 000 000 kilowatt hours. The penstock has a total length of about 15,200 feet and it is made up of a series of steel pipes of different diameters and thicknesses according to the head of water The power plant is equipped with four units of 3000 horsepower each arranged lengthwise with ample clearance to provide a maximum degree of safety in case that, for instance, a bucket should fly off The waterwheels are of the Pelton type, and their construction and the design of nozzles and valves was unusually difficult, owing to the large head under which they operate Each 3000 horsepower unit is driven by a stream of water of seven sec. feet issuing from a nozzle of 1⅜ inches in diameter at the enormous velocity of about 540 feet per second —*English News Record* 91 10, pp 395-96.

The Resistance of Concrete to Wear has been studied at the Structural Research Laboratory of the Lewis Institute, Chicago It was found that the grading of the aggregate indicated that up to a certain limit the coarser the aggregate the lower the wear These tests are difficult to summarize, but we may give two instances of 1 4 mixtures of cement and aggregate With sand and crushed granite the least wear was shown with 20 per cent aggregate up to ⅜ inch size, 20 per cent between ⅜ inch and ¾ inch and 60 per cent ¾ inch to 1½ inch size. With crushed limestone the best proportions would appear to demand the rather larger use of the coarse at the expense of the intermediate grade The grading may, however, vary over a wide range without affecting the results appreciably, while the wear of concrete does not depend so much upon the character of the coarser aggregate as is commonly supposed The proper grading has much more influence according to these tests than the class of aggregate. The best results from the point of view of wear were obtained with granite, although sometimes considered not an altogether satisfactory class of material and not showing up in the strength test above the average Blast furnace slag and limestone with the most suitable gradings gave results as good as those for granite, but the falling off with other proportions was greater than for granite.—*Engineering*, 116 3006, p 182.

The English Channel Tunnel Project is kept alive by its promoters, although the British government persists in refusing to grant the necessary authority, largely for national and strategic reasons. The material to be encountered for the entire distance is very favorable, being a deep bed of chalk marl, or chalk infiltrated with clay That this material does not swell on exposure and is impervious is shown by the trial heading built in 1880-1881 and extending about a mile under the sea With the boring machine designed for this work, and used experimentally, a heading twelve feet in diameter can be driven at the rate of 120 feet per day and two machines started at opposite ends should meet in less than three years It is proposed to complete this pilot tunnel or heading and then its enlargement to full section could be started at various points, so that the time for the completion of the concrete-lined tunnel is estimated at 4½ years Instead of the usual mucking operations, the excavated material would be mixed with water to form a grout and then pumped to the surface With present prices the cost is estimated at $145,000,000 —*English News Record*, 91 16, 645

Alumina Cement was invented in 1908, but its adoption has been comparatively recent in France, where it was invented It is very high in alumina resistant to sea water and to sulfate waters, and hardens with extreme rapidity so that in a day or two its concrete shows the same results as a normal portland cement concrete after a month or more The new alumina cements are made by fusing a mixture of bauxite (aluminum ore) and limestone in a furnace, and grinding the product to powder The carefully weighed opinions of a number of eminent engineers in France, Great Britain and the United States give results ranging between 10 per cent and 20 per cent of the portland output as representing the amount of alumina cement that we can reasonably hope to make and sell within the next ten years. Alumina cement will always be in most parts of the United States dearer than portland cement, and in many regions it will be very much dearer That means that it will be to some degree a specialty product, used for such purposes or under such conditions as will justify its extra cost per barrel Along sea coasts and in the alkali region of western Canada and our own western states, alumina cements will be used provided that they are not too dear because they are resistant to chemical attack Elsewhere, on repair or construction work where time is an object, alumina cements will be used so far as their higher cost per barrel is counterbalanced by saving on time labor and forms. *English News-Record*, 91 9, pp 347-49

General

Pollution of Coastal Waters by Petroleum Oils can eventually be eliminated through the cooperation of the parties concerned, according to preliminary findings of a committee of representatives of the Bureau of Mines, the American Petroleum Institute, and the American Steamship Owner's Association Remedial measures studied by the committee include oil water separating devices on oil burning ships and tankers, the providing of facilities in harbors for the collection and proper disposal of oily wastes and the use of apparatus from land plants. The committee found pollution by oil to be present in some degree at most of the 35

(Continued on page 54)


Radiotron
REG. U. S. PAT. OFF.
Radiola IV
Radiola II
In high quality receiving sets, the vacuum tubes—the heart of their fine performance—bear the name Radiotron and the RCA mark. Be sure to look for this identification when you replace your tubes
RCA
This symbol of quality is your protection
Radiola V with Loudspeaker
Radiola Grand
Radiotron WD-11
Radiotron WD-12
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Scientific American Digest

(*Continued from page 52*)

places visited on the Atlantic and Gulf coasts. The operators of a certain large fleet of tankers have developed what is believed to be a promising oil-water separating device for use on oil-cargo vessels. In the absence of separating apparatus aboard ship, the use of barges for collecting oil-contaminated water and oily refuse, in connection with adequate facilities for the proper treatment and disposal of such wastes, offers the most immediately available means for coping with the situation after the vessel has arrived in port.—*Nautical Gazette*, 105 14, p 372.

Water-line corrosion takes place over a narrow range at the point where the metal emerges from the liquid Many theories have been advanced to account for this effect. The true explanation was suggested by a phenomenon frequently seen during the corrosion of metallic anodes by use of the electric current, where the dissolving of the metal creates a film of condenser solution next to the metal, which can be seen to flow down along the surface of the anode and stream off from its lower end Water-line corrosion was thought to be due to a similar circulation which keeps all of the metal plate except that near the liquid surface in contact with partly exhausted solution, and causes the metal at the surface of the liquid to be bathed by the stream of fresh solution which is drawn in to take the place of that which flows downward along the metal surface To determine if such circulation actually takes place in cases of water-line corrosion, a strip of copper was placed in a narrow stereopticon-cell containing normal sulfuric acid, to which fifty grams per liter of potassium bichromate had been added, and the corrosion process was watched by transmitted light. In a few minutes the expected circulation was clearly visible, and a constant stream of corrosion products flowed down the specimen and off the lower end.—*Chem and Met Eng*, 29 16 pp 700-08.

The British Aircraft-Carrier Hermes, is the first aircraft-carrier in the world to be designed and built for the purpose of carrying naval seaplanes other ships of the type having been converted from various types of warship. Roughly, she is 11,000 tons, with a speed of 25 knots and an armament of seven six inch guns, but the ideal which the naval constructor now has in view is a ship of at least 20,000 tons displacement, with a powerful battery preferably of 7.5-inch guns. In the matter of speed it is felt that the Hermes is too slow after the experience with the converted aircraft-carrier Campania, which showed that such a ship should be at least two knots faster than the man-of war with whom she is operating in order to give her time to come into the wind to launch her machines without dropping right astern of her consorts and necessitating the detachment of destroyers for her protection Similarly, the general opinion now is that 20,000 tons displacement is the minimum with which a carrier can expect to be operated efficiently if she is to pick up exhausted machines under service conditions.—*Naval and Military Record*

Flying Tenders for Submarines.—The United States Navy has decided to fit all its ocean going submarines of the "S" "T," and "V" classes with special small seaplanes. These air craft can be struck down and stowed on board a submarine or patrol vessel without difficulty Should any naval Power in future warfare use under water craft against merchantmen, the added danger of a flying tender can well be imagined for there would be no longer any hope of eluding the enemy by dazzle painting to disguise the course and speed of the ship, or by apparatus for concealing smoke except, perhaps, in narrow waters, where the enemy would not dare to stay sufficiently long on the surface to get the seaplane away The machine would not be used for bomb-dropping, but would probably follow the tactics of the seaplane tender of the German raider Wolf, which not only acted as scout and greatly increased her range of vision, but also flew on ahead and opened fire on her intended victim with machine guns, which generally persuaded her to stop and await the arrival of the raider It would also mean a very considerable alteration in our war time ideas of anti-submarine patrols, as little craft like motor launches would afford small protection against machine-gun fire unless they had so much steel armor that their speed would be seriously impeded —*Naval and Military Record.*

The new mechanical parcel post mail sorter consists of a rotary rack for the mail bags into which parcels are thrown by the men who do the work of sorting at the office of initial dispatch In the past the racks have been fixed. In the new device the bags are attached to a rack which travels on an elliptical track. The sorters work on a platform alongside the rack. Mail is delivered to them by means of chutes from the receiving division of the office The mode of operation is simple Each bag is marked by a tag of conspicuous coloring. In the tests now under way at Chicago the tag for Ohio may be a brilliant red and that for Vermont may be green and white Picking up a parcel for Ohio, the sorter spots a red tagged pouch and throws the package into its open mouth As Ohio is near by, and receives a considerable volume of mail from the Chicago office, there are several bags for this one state, and it is certain that one of these will be near the sorter, involving no wait On the other hand, Vermont receives relatively little mail from this office, and the green and white tag may be at the other end of the platform. In this event the sorter merely deposits the parcel on the shelf between him and the rack, and waits for the Vermont bag to appear When the bags are divided into 60 designations, or "separations, as they are technically known, the speed is as great as when there are but 30 In using the stationary rack the speed decreases with the increase in the number of destinations In handling large parcels the rotary rack is especially effective. Tests show that in eight hours the sorters filled 1500 sacks, ten parcels to a sack, at the rate of seven parcels per man per minute This is practically twice as rapid as the handling of similar parcels by use of the stationary racks The great saving comes through the elimination of lost steps on the part of the sorters, in walking from end to end of the racks on which stationary sacks are mounted, The rotary rack, with modifications based on the Chicago experiences, will probably be installed in all important postoffices.—*Manufacturers' Record*, 84 16, p 87

Rebuilding devastated Japanese areas will require, according to the National Lumber Manufacturers' Association, over a thousand shiploads of three million feet each to rebuild the devastated areas, and America is the only country that can quickly respond and whose output is equal to such a demand The Japanese trade, according to the Association, formerly called for squares, ranging in size from 4 x 4 in (10 to 20 ft. lengths) to 24 x 24 in. (24 to 40 ft. lengths), all in merchantable grade The combined resources of British Columbia, Washington and Oregon cannot furnish over a billion feet of these sizes and grades in a year, says a prominent lumberman of the West Coast, and if the demand is as great as estimated, lower grades and sizes must be used Reports to the U S Department of Commerce place the destruction of buildings at 310,000 in Tokio and 70 000 in Yokohama At the time of the disaster large reserve stocks of lumber were stored in Kobe, Osaka, Tokio and other cities The real demand, according to the lumber manufacturers, will come when the permanent construction of the devastated areas commences. Advices received from the Consulate General of Japan at New York, and made public by the U S Department of Commerce, state that by an Imperial ordinance building materials and necessities of life will be exempted from import duty until March 31, 1924.—*Eng News Record*, 91 16 ·660.

Methods of disposal of privy wastes in rural districts were investigated by the United States Public Health Service with interesting results. It was found that fecal bacteria, made visible with uranin dye, progressively followed in the ground water for distances of 3, 6, 10, 15, 25, 35, 45, 50, 55, 60 and 65 feet from the trench in which the pollution was placed, uranin has been recovered from these same wells and has spread to other wells at 70, 75, 80, 85, 90, 95, 100, 110 and 115 feet from the pollution trench The soil in question is a fine sand with an effective size of 0 13 millimeters. The pollution has traveled these distances within a period of 187 days, or about 27 weeks, and only in the direction of the flow of the ground-water, no convincing evidence is present that the pollution has traveled against the flow of the ground water or at right angles to it. The pollution has traveled only in a thin sheet at the surface of the zone of saturation there is no evidence at present that it has dispersed radially backward, and even when heavy pollution

is recovered at the top, water from lower levels (in near by deeper wells) is negative both for uranin and for B coli.—*Eng News-Record*, 91 11 425.

Industrial Progress

Increasing the Diesel engine's thermal efficiency.—The most successful utilization of waste heat is that effected in the Still engine, in which steam raised from the jacket and exhaust of an internal combustion cylinder is applied on the opposite side of the piston By such means the thermal efficiency has gained another 7 per cent, thus bringing the total up to 41 per cent This engine has passed its experimental stages, and is now being manufactured as a four stroke, single-piston heavy-oil engine, in sizes up to 1000-brake horsepower for land purposes and 350 horsepower per cylinder for marine propulsion —*The National Engineer*, 27 9, p 420

A gas apparatus designed to utilize fuel-oil distillate in the manufacture of gas for commercial and domestic purposes has been perfected at Buffalo The new process is said to be more economical than the manufacture of coal gas, while the plant apparatus necessary in the making of gas from fuel-oil distillate is much lower in cost than coal gas apparatus The gas produced it is claimed, has five times the heating value of producer gas, contains no sulfur, and burns with a non-oxidizing and non carbonizing flame The gas has given satisfactory results in direct application to heat treating of ferrous metals and in japanning and enamelling Tests have proved the gas suitable for lighting and heating and for domestic purposes, comparing well with coal gas in thermal efficiency Four gallons of fuel-oil distillate are required per thousand cubic feet of gas One attendant can operate a plant having 500,000 cubic feet capacity per 24 hours, hence the operating cost is low —*Gas Ind*, 17 9, p 297

The first Diesel electric pipe-line dredge to be placed in service is being built in Portland Oregon This dredge has a fifteen inch discharge and it is estimated that the saving in operating costs of this dredge over a steam dredge of like capacity, will be as much as $15 000 a year Instead of the customary direct current drive, alternating current is used so that if desirable, outside power can be used The power plant consists of a 525 brake horsepower Diesel engine of six cylinders which is run on ordinary fourteen-degree Baumé fuel-oil The main generator operates at 2300 volts —*Motorship* 8 8 pp 558 59

The first welded gasholder was fabricated in Melbourne in 1922 This tank is 200 feet in diameter by 105 feet deep and is built of 9/64 inch steel When finished it contained some fifteen miles of welding and when tested with soap and water there were only six leaks For some time oxy acetylene welding was employed, but was ultimately discarded as unsuitable largely owing to the difficulty of overhead welding Attention was then directed to the use of electric welding and 250 experiments were made to test various types of joints and electrodes Ultimately that employed was the quasi arc process. From the tests, the tensile strength of the joints was invariably found to be equal to if not greater than the sheets themselves —*Gas World*, 79 2047, pp 325-27

The Young Whitwell backrun gas process is a new development in the art of manufacturing illuminating gas which was brought about largely through the desirability of using cheaper fuels, and at the same time utilizing equipment already in existence Through slight changes in the construction of any ordinary water gas set, this process renders available as generator fuel either coke or bituminous coal Remarkable results have been obtained when slack bituminous coal and heavy oils have been employed The operating economies provide for the substitution pound for pound, of slack bituminous coal for coke Its improvements over the old methods and equipment and its marked operating savings depend upon utilization of cheap fuel, lessening of heat loss, reduction in maintenance and depreciation, decrease in gas-oil used to give a required thermal value, elimination of the expensive and complicated hot valve and small capital outlay in installation The process is applicable to any water gas set, after certain changes —*Chem and Met Eng*, 29 15, pp 664-69

A new compound fertilizer which is manufactured by a French company is based on the idea of neutralizing the residual acid

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ity of ordinary super phosphate with am monia gas By utilizing the ammonia gas in low concentration—say, three to five per cent—and carefully controlling the tempera ture of the reaction, not only can the previ ously recognized danger of retrogradation of the phosphoric acid positively be averted, but the resultant compound fertilizer is obtained in a perfectly dry and friable condition, and a homogeneity much greater than that of simple mixtures In this process a saving of 48 per cent of sulfuric acid is claimed —*Chem Trade and Chem Eng*, 73 1897, p 360

A new type of boiler furnace designed to operate with pulverized fuel has been de veloped, in which a combustion rate many times in excess of the rate recommended at present has been maintained This furnace is known as the Cannon radiating furnace As much as 60 per cent of the total heat of combustion will be delivered to the boiler by radiation at a combustion rate of 250,000 B t u per cubic foot of combustion space per hour Each furnace will be fed by a single simple straight pipe burner located in the wind box at the front Pulverized coal will be carried from the feeder to the burner at a suitable velocity by means of low pressure air This furnace will operate under forced draft The flame starts in the lower cham ber just a few inches beyond the burner tip and extends to the rear thence upward into the rear of the top chamber and back to the exhaust opening Thus the flame passage is double the boiler tube length under normal conditions while the cross section of the gas stream in the furnace is small compared to the total length This produces a very con tinuous mixing of the combustible matter with the oxygen and because the walls sur rounding the gas stream are at a high tem perature makes it possible to burn the fuel rapidly and with a minimum amount of ex cess air When surrounded with water absorption surfaces the exterior of the fur nace surface will be at 1600 degrees F —*Combustion*, 9 4 pp 307 11

A record of 450 rivets in a working day of eight hours has been the average per formance of the bull riveter in use on the penstock work on a power tunnel at Niagara Falls This is the same riveter which the artist used as his inspiration for the cover design of the November issue of the SCIEN TIFIC AMERICAN On a regular run 45 rivets in 35 minutes was the schedule The saving in labor effected by the riveter is computed at 66 per cent The average work of a crew of seven men hand riveting is 150 rivets in an eight hour day With hand driven rivets a percentage must be allowed for cutting out loosely driven rivets—a condition not found in the machine driven work The rivets used on the penstock job were 1½ inches in di ameter —*The Boilermaker* 23 9 p 258

Experiments on the dry cleaning of gas with dust which were conducted at the Pittsburgh Steel Company plant during the past summer show the great possibilities of this method of purification As a result of these tests it is believed that beyond the dry cleaner lie tremendous possibilities as a result of its use In the nature of conser vation of sensible heat of the furnace gas there is better combustion in stoves and boil ers with resultant decrease in power costs due to elimination of labor in upkeep and repair of equipment as a result of complete recovery of flue dust Thus at the average furnace where no special attempt is made or ineffective means are employed to recover the dust, may run as high as 60,000 tons per year The extremely low dust content of gas cleaned by this method makes it possible to clean that part of the gas to be used by gas engines, by passing it through an indi rect cooler in which the gas is cooled and the moisture condensed bringing down with it the remaining dust, thus accomplishing complete cleaning and recovery of the last trace of dust without bringing the gas into direct contact with water —*The Iron Age*, 112 17 1111 14

Metallurgy

Red stains on sheet brass are found to be caused by reactions of copper oxides in the scale formed during annealing and the pickling medium, cupric oxide contrary to usual opinion is as harmful as cuprous oxide Oxides of copper may be present from vari ous causes such as careless washing after the pickling operation, resulting in the pres ence of acid and salts during the subsequent annealing, the presence of iron in the brass

or upon its surface and the use of impure rolling oils. However, the main cause of the oxidation of the copper is the use of the old fashioned annealing furnaces, in which the flames impinge directly upon the brass — *Metal. Ind.*, 21 10, p 394

Effect of temperature on the tensile strength of steel —An increase of temperature of steel results in a decrease of tensile strength But it is not so generally known that there is first a lowering and then an increase of strength during the early stages of heating The average temperature at the maximum strength for all the steels is about 540 degrees, and the average for the lowest, prior to reaching the maximum, is about 230 degrees. So that it may be stated roughly, that the tensile strength of ordinary steel is at its minimum at about the boiling temperature of water and that it reaches its maximum at about 550 degrees Fahrenheit. After this last temperature has been reached there is a steady fall in strength as the temperature rises, until when 1600 degrees, or a cherry red heat, is reached the strength has been pretty well lost All steel cutting tools hold their edges better when heated above the temperature of the atmosphere than when worked cold A razor shaves better if raised to a little above the blood temperature A finishing tool will cut more smoothly when warmed —*Railway and Loco Eng* 36 10 pp 308-9

The addition of 5 per cent of nickel to a 5 per cent chromium steel practically produces a steel which is almost resistant to nitric acid, while as regards hydrochloric acid the addition of nickel very materially increases the resistance As regards sulfuric acid the gradual increase in nickel content is responsible for the production of a steel which is only very slightly soluble Two other steels, consisting of a 10 per cent chromium steel without nickel and one with a 5 per cent addition of that element show a marked increase in resistance to sulfuric acid owing to the addition of nickel The hydrochloric acid results are apparently in the opposite direction The general effect of the addition of nickel to a chromium steel is to increase the resistance to nitric acid, to materially increase the resistance to sulfuric acid and to tend to increase the resistance to hydrochloric acid The addition of such a comparatively small percentage of chromium as 5 05 per cent has a profound effect in modifying the response of the steel to nitric acid, and in materially reducing its solubility in hydrochloric acid —*Engineering*, 116 3013, pp 415 16

The spangled surface of galvanized metal has always been a goal sought for by manufacturers of galvanised iron goods Various causes have been blamed for failure to secure this result, but researches recently made show that the base metal iron or steel has practically no influence on the result if the temperatures are satisfactorily maintained Pure zinc did not yield the desired large spangles, and tin or aluminum likewise failed, but the addition of lead did so immediately The separation of the impure zinc forming the layer on the metal sheet into conjugate solutions—lead rich and zinc-rich—at the dipping temperature, and the method of subsequent crystallization were the causes of the effects obtained This was proved by the analysis of different types of spangle occurring on the same sheet and by the observed differences in the rate of attack of different spangles forming the coating The separation is attributed to the difference in the surface tensions of the two solutions.— *Metal Ind*, 21 10, p 394

***The density and composition of metals* and alloys under two rates of cooling,** fast and slow, as produced by casting in chill and sand molds.—The densities of pure metals are not affected by the rate at which they solidify This is also true of those alloys which solidify at a constant temperature In the case, however, of those alloys which solidify over a range of temperature, the rate at which they pass through this range seriously affects the density, the slower the rate of solidification the lower being the density When alloys which possess a long solidifying range are prepared in cylindrical chill molds they are less dense in the center than at the outside Rapid solidification has a pronounced effect on the composition throughout the mass of those alloys which solidify over a range of temperature When prepared in chill these alloys are found to be richer on the outside in the component of the lower melting point and richer in the center in the component of the higher melting point. Sand castings in these alloys are uniform throughout. Alloys which solidify at

a constant temperature are uniform in composition throughout, whether prepared in sand or chill molds.—*Metal. Ind.*, 21 10, p. 396.

The corrosion of metals is found by experiments to be mainly, probably entirely, electrochemical in character There are two main types. That accompanied by evolution of hydrogen gas is characteristic of reactive metals placed in acid solutions, but the velocity varies greatly with the degree of purity of the metal Where this type is impossible, slower corrosion can take place at a rate determined by the diffusion of oxygen to the metal, and comparatively independently of the purity When a metal is immersed in a solution of potassium chloride one can observe the production of alkali at the cathodic portions, the production of the chloride of the metal at the anodic portions, and the precipitation of hydroxide where these meet The electric current, when measured, accounts for the greater part of the corrosion. Generally the cathodic areas are those to which air has free access, while the anodic areas are those protected from aeration and it is significant that corrosion usually proceeds most rapidly at the comparatively unaerated places—hence the intense corrosion observed in the form of pits and over areas covered up by porous corrosion products.—*Metal Ind* 21 10, p 396.

Electricity gaining ground in metallurgy—The first electrolytic iron plant in the United States was started less than a year ago in Connecticut and the subject has attracted considerable attention inasmuch as a very pure iron can be produced in this way and the smaller the undesirable impurities in iron the less it will rust There are three distinctive ways that electricity is now used in metallurgy first, for heat treatment of ores and ore products in electric furnaces second, for depositing the metals from solutions obtained by leaching the soluble constituents of an ore and, third, for the refining or separating of metals already essentially free from undesirable elements. Some of these applications have not yet reached commercial importance so far as certain metals are concerned but there is little doubt that development will be rapid —*Eng and Mining Jour Press* 116 14, p 575

A new method of hardening high-speed steel has been developed by a Chicago manufacturer which obviates many of the difficulties of the former method, especially that of getting the correct method of heating the parts to be hardened The tool is heated in a protected atmosphere for a predetermined time and temperature, and is cooled and drawn at a predetermined time and temperature which results in the full development of the cutting structure throughout the entire piece at the lowest possible temperature It has been determined by carefully conducted experiment that the complete carbide transformation is obtained in the standard modern high-speed steel at between 2200 and 2210 degrees Fahrenheit when held accurately between those temperatures in a protected atmosphere for a sufficient time to complete the change The tools are placed in a container of a special alloy surrounded by charcoal, and covered The box and contents, after pre-heating are raised to a temperature within the critical range where the carbide transformation takes place and held there a sufficient length of time to complete the change The resultant tools are stronger and have several times the cutting efficiency The method guarantees against overheating of the cutter, tool or part and the protected atmosphere assures the material being hard up to the very surface It also corrects materials which are somewhat out of balance and consequently have a prolonged "lag"—*Forging-Stamping Heat Treating*, 9 9, p. 375.

Chromizing consists in packing the material to be treated into a powdered mixture of 45 per cent alumina and 55 per cent chromium The material is usually packed into a tube of iron and then heated at 1300 to 1400 degrees Centigrade in hydrogen, in vacuum or in some neutral atmosphere, for lengths of time depending upon the penetration and concentration of chromium desired The chromatizing furnaces consist of alundum tubes wound with molybdenum wire as a heating unit The non-corrosive chrome-iron alloy is a solid solution of chromium in iron, and is made up of an area of elongated grains, with their longer axes perpendicular to the surface In order to get the best results an iron or steel of low carbon content must be used In cases where the material chromatized must stand high tension and fatigue stresses, the high temperature of

chromatising lowers the resistance of the material, but by proper heat treatment the original properties may be almost restored Carbonising of chromatised iron lowers its resistance to corrosion, and polished samples which have been case-hardened will show numerous globules of water if allowed to stand in the open air for only a short time — *Brass World*, 19 9, pp 291 92

Mining

The question of the origin of petroleum is very complex In many cases we have reason to believe that the petroleum was not formed in the strata in which we find it The bulk of the oil of a field may have been pro duced under fairly uniform conditions but each minor occurrence may also have passed through its own history of production and development under special local conditions As regards parent material or materials, we have only suppositions. The oils—as distinct from petroleum—we commonly deal with are all of organic origin, vegetable or animal Petroleum may have the same origin, and of late the view has been gaining ground that the occurrences of petroleum and coal are interrelated But the advocates of an animal origin of petroleum have by no means given in the possibility of an inorganic origin also continues to find support, and the great variety of petroleums suggests various parent materials and modes of production At pres ent there is no agreement, not even on essen tial points. —*Engineering*, 116 3015 pp 466-67

Pollution of public water supplies by mine drainage has become a serious matter in some parts of the country particularly in the bituminous districts of Pennsylvania Sulfur and iron appear in the coal in the form of pyrites, which, coming in contact with air and water, causes chemical changes which produce an acid drainage Coal in situ has no effect on the quality of the water in the streams on which it outcrops It is the impurities, such as iron and sulfur, in the coal coming in contact with air and water after mining is started that produce chemi cal changes which result in the formation of acid drainage. Before mining is started, the coal in place and undisturbed acts as a barrier to the percolating waters above and prevents the water and air from coming in contact with the impurities, and for this rea son a virgin field of coal has no detrimental effect upon the purity of the streams It is believed that the added expense of treating mine water would not exceed ten cents per ton of coal mined. It is suggested that, to obviate the necessity of treating the mine water from abandoned mines, or at least to have the volume of such drainage reduced to a minimum, it should be unlawful to mine any coal within the area included between the outcrop and the line of 20-foot cover — *Eng News-Record*, 91 16, 638-41.

The outstanding feature of the development of technical practice on the Witwatersrand during the past few years has been the adoption of what may be termed the all sliming process. This process may be briefly described as single stage crushing in conjunction with improved meth ods of tube milling On account of the rela tively small capital cost involved in the plant and the high percentage of extraction that is possible, it is thought that the process of fers great possibilities to the small man it being possible to provide a unit plant capable of handling from two to three thousand tons per month. It is designed to recover either by blanketing, amalgamation or cyaniding at a very considerably lower cost than would be incurred with the usual type of plant — *S African Min and Eng Jour*, 34 1667, p. 775

Prospecting with the Eötvös balance.— The value of this instrument consists in measuring the extremely small changes in gravity caused by lighter or heavier masses in the earth's crust. The instrument is so sensitive that it enables one to measure differences in the force of gravitation with any accuracy exceeding many thousand times that of the most analytical scales. In principal it is identical with the torsional balance first used by Coulomb to investigate the laws of static electricity In Germany a concern has recently been making these in struments, whose readings are made automatically by photographs, and a few are now in use in the United States and Mexico It requires the handling of an expert and is not reliable in hilly country, but is best adapted to oil, salt and coal fields.—*Eng and Mining Jour -Press*, 116 14, pp 588-89

Transporting marl with compressed air is an ingenious new method used by a Michigan cement plant for conveying their material from the source of supply two miles distant from their cement plant The marl is dug by means of an orange peel bucket dredge and deposited in a separator for the removal of roots pebbles and foreign matter which might clog the pumping system The air is compressed in a compressor driven by a 75 horsepower motor Two circular steel tanks, five feet in diameter and five feet high located next the storage vat, are con nected with the receiver and compressor through an automatic switch which operates in such a manner that air is drawn from one steel tank forming a vacuum and causing the agitated marl slurry to rush into this tank, filling it, while the other tank is placed under discharge The twelve inch pipeline to the mill is 10,000 feet long and has two relay stations, with receiving vat, compressor and pumping station No difficulty is experienced in transporting the marl the greatest relay distance of 4 400 feet with a difference of ele vation of 30 feet using 75 to 90 pounds of air pressure Marl slurry containing 50 per cent moisture can be pumped effectively — *Cement and Eng News*, 35 8 pp 34 36

Platinum in the United States.—The main source of the world's supplies of plati num is normally Russia, which once had an output of 300 000 ounces per annum, derived from gravel beds As a result of the war the price of platinum is about three times what it was formerly, and the temptation has been considerable in this country to boom plati num mining To this end all sorts of properties have been pronounced to be capable of producing platinum from ores of various kinds, and even shales and sands As a mat ter of fact, this country is practically desti tute of platinum as it is of nickel and tin, and the cases in which the United States Bureau of Mines has been able to check claims advanced have revealed at the most practically unworkable traces of the metal Platinum was the subject of a good deal of prospecting and assaying on the part of the Bureau during the war, when it was thought that such work might reveal sources of sup ply which would then have been very valu able The work then and since carried out served for the most part to convince the offi cials that the platinum resources were how ever, very small At its best the United States has produced less than 1000 ounces a year, and that as ancillary to the working of gold, silver and copper without which the platinum recovery would have been uneco nomical The Bureau's investigations have led to the examination of a large number of samples in most of which no platinum whatever was discovered though rich claims had been made and certified In one case platinum was found in the form of soluble platinum salts and sponge neither of which exists in nature to quote the damaging judgment of the Bureau another sample revealed wire and foil therein —*Engineering*, 116 3006 p 187

Mining Engineering

Holding machine work by vacuum —To provide for holding large quantities of small pieces made of either ferrous or non ferrous metals and non metallic work such as rub ber, fabric, wood or glass, a Detroit (Mich) company, after considerable experimenting has developed a line of chucks that utilize vacuum for holding work. In each of these vacuum chucks there is a chamber which is made air tight when the work is placed over it either by the work covering the entire surface or by other means A vacuum is then created by pumping all the air from the chamber, and as this is done the work grad ually becomes secured to the chuck by atmos pheric pressure As atmospheric pressure is approximately 14 7 pounds per square inch at sea level a piece, say 4 inches long by 1 inch wide (provided full vacuum has been created and practically the entire bottom of the piece is exposed to vacuum) will have a downward pressure of almost 60 pounds tending to keep it from slipping on the chuck as the cutter is applied When full vacuum has been created, the limit of holding power is obviously reached, and the pump then simply operates to maintain this vacuum — *Machinery*

A resume of the progress made in cen trifugal casting shows that the principal commercial application of the process until recently has been in the casting of large cylinders of considerable length, in non duc tile alloys, such as red brass, aluminum alloys, etc. Cylinders of twenty feet or more in length and 2000 pounds in weight have been made without difficulty During the war

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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

A Capacity Finder has been introduced by a manufacturer of radio condensers. This consists of two strips of metal across which are bridged five fixed condensers of different capacities The two strips are connected with the grid circuit, and it then becomes possible to try various capacities until the best results are obtained The device is then removed and a fixed condenser of the desired capacity is put in its place

Variable Resistance and Capacity for grid control are provided in a single device which has recently appeared on the market. The resistance may be varied in a gradual and positive manner from one fifth to twelve megohms while the capacity may be gradually varied from .000002 to .005 mfd according to the manufacturer It is said by those who have employed this grid control that signal strength is increased 25 per cent in the case of critical circuits such as the Reinartz

New Radio Circuit for Poland.—October 4th marked the opening of direct radio communication between New York and Warsaw the station of the Radio Corporation of America working with the new Polish Government station just completed in the latter city This makes the seventh direct circuit to Europe operated from New York City The importance of this communication to the two countries concerned is indicated by the fact that during the calendar year just past 71 per cent of the total international telegraphic traffic of Poland was with the United States

The Riverhead Receiving Station of the Radio Corporation of America was planned for a capacity of nine receiving sets so we learn from a paper recently read before the American Institute of Electrical Engineers Of these, six are now in daily operation Mutual reactions are minimized by careful screening of the various component elements and by the astatic winding of coupling coils In addition a two stage filter is introduced in each circuit between the detector and the audio frequency amplifier These precautions have made it possible to operate the several sets with the same filament and high tension batteries without trouble from back coupling

The Trans Atlantic Broadcast Tests formed an interesting feature of National Radio Week which was observed from November 25th to December 1st Various broadcasting stations abroad and likewise here were connected together by land line so as to function as powerful units from a common microphone Our leading broadcasters were intercepted by British amateurs just as British stations were intercepted by American amateurs Nevertheless the fact remains that trans Atlantic broadcasting reception requires the most elaborate type of super heterodyne receiving sets, which are available to only a very small number of amateurs

The Autoplex Circuit is the latest to attract the attention of those who like to build their own sets and who are forever seeking something different The autoplex circuit is in reality a super regenerative set. It makes use of two standard variometers, one for the grid and the other for the plate, an L 1250 coil in the antenna ground circuit a filament battery rheostat and vacuum tube and the usual "B" battery and telephone or loud speaker Indeed the autoplex will operate a small loud speaker without amplification which makes it rather unique among the usual run of receiving circuits. As it now stands it appears that the autoplex circuit is by no means a polished product Unless it is properly constructed and manipulated it produces distorted sounds Nevertheless it represents some interesting experimental possibilities for those interested in the experimental side of radio

Transmitting Efficiency.—In no branch of radio telegraphy has greater progress been made during the last two or three years than in the design of the grounding systems of large transmitting stations according to Prof G W O Howe, writing in *The Electrician*. For many years the effectiveness of a station was judged by its so-called power in kilowatts, which sometimes was supposed to represent the power actually supplied to the aerial, but more often represented the power supplied by the dynamo or alternator to the transmitter The power actually radiated from the aerial was rarely considered, though this, after all, was the only thing that mattered It is now fully realized, however, that the only measure of the effectiveness of a station is the radiated power and since, for a given frequency, this depends on the product of the effective height and current this product is now specified instead of a meaningless number of kilowatts To obtain the maximum radiated power for a given total power delivered to the aerial every effort is now made to reduce the various losses These consist of the losses in the aerial wires, tuning inductances, etc., and in the towers, stays, etc, losses due to brush discharge from the wires, and last, but by no means least, losses in the earth under the aerial

Why Radio Signals "Fade."—For several years back the Bureau of Standards has been engaged in experiments aimed at ascertaining the cause of 'fading' radio signals The Bureau conducted tests during 1920 and 1921, with the cooperation of the American Radio Relay League In these tests, states the Bureau of Standards, from five to ten radio stations transmitted signals in succession on certain nights, according to prearranged schedules The signals were received simultaneously by about 100 receiving stations whose operators were provided with forms for recording the variations in the intensity of the signals as received The general result of these tests substantiates the theory that the sources or causes of fading are intimately associated with the conditions at the heaviside surface which is a conducting surface some sixty miles above the earth Day time transmission is largely carried on by means of waves moving along the ground while night transmission especially for great distances and short waves, is by means of waves transmitted along the heaviside surface Waves at night are thus free from the absorption encountered in the day time but are subject to great variations caused by irregularities of the ionized air at or near the heaviside surface These variations probably account for fading

The Sodion Detector Tube, invented by H P Donle chief engineer of the Connecticut Telephone & Electric Company of Meriden Conn, has now made its bow to the radio public Several years ago we described in these columns the interesting development work on vacuum tubes being conducted by Mr Donle, and more recently we told of his latest tube involving the use of a sodium element The characteristics of the present commercial product are quite similar to those of the former experimental tube The present form differs in that no liquid sodium electrode is used The outstanding features claimed for the sodion tube are high sensitiveness (about two stages greater than the hard grid tube detector), pure quality of tone production, stability in operation and absence of all interference producing squeals and whistles as the tube cannot be made to oscillate or regenerate in itself Like the previous type we learn from *Electrical World* this tube has no grid, but utilizes a trough shaped piece of nickel, partially surrounding the filament and open toward the anode as its control electrode A glass shell contains the anode or plate the filament and the collector or control electrode A heater is wrapped non magnetically around the outside of the tube and a second external glass shell is placed over all elements for protection and to conserve heat The tube is pumped to the highest possible vacuum and internally treated with an alkali metal (sodium) to provide the stable ionizing material that plays an important part in its sensitiveness.

A New Sound Amplifier.—To amplify the sound of a voice so that many persons may hear it throughout a large room, various methods are possible, utilizing properties of flames, compressed air, electrical currents etc. Writing in a recent issue of *Comptes Rendus*, L Gaumont states that the sounds

are, in general, distorted because of the mass of the vibrating parts which serve to reproduce and transmit the sound M Gueritot recently suggested a new electrical arrangement, which resolves all the problems of voice transmission The vibratory part is formed by a cone of fine silk, on which is spirally wound a very fine wire conductor, preferably of low density, *e g*, of aluminum This cone is placed between the poles of an electromagnet, the poles being shaped exactly to fit the cone, and a *circular collar* fixes the base of the cone to one of the poles Telephonic currents are passed through the *winding of the cone*, and under the action of the magnetic field it is set into vibration, and, having practically no natural oscillation, it has no difficulty in reproducing the sounds which have caused the electrical currents To allow the transmission of the sounds so produced a number of orifices are present in one of the pole pieces, and these orifices are at the apex of the horn It is stated that with such an arrangement the voice may be heard in a large room and with the aid of the vacuum tube amplifier orders can be given verbally above the noise of a machine shop *For outdoor use it can* be employed from ship to ship or ship to shore, and in railway yards

A Receiving Tube with Alternating Current Filament Heating has been worked out. The special feature of this tube *is the cathode unit*. This *consists* of a cylinder of nickel coated with a mixture of barium and strontium oxides The material is 0 003 inch thick, and the complete cylinder is ⅞ inch long, with an inside diameter of approximately 0 08 inch The heating element is a filament of tungsten 0 0035 inch in diameter and 2 inches long in the form of a V with the sides parallel and about 0 010 inch apart To maintain the relative positions of sleeve and filament and to insulate the sides of the filament from one another, a tube of refractory insulating material is used This tube has an outside diameter of 0 085 inch and is pierced with two longitudinal holes 0 005 inch in diameter and 0 010 inch apart The cathode sleeve is supported at the top by a strip welded to it (leaving the filament free at the top) and a lead is brought out from this strip so that the connection can be made to the cathode quite independently from the alternating current supply leads to the filament The grid is a helix of nickel wire and the anode a nickel cylinder ¾ inch long and ⅜ inch diameter The tube operates with an alternating current of 0 85 ampere at about 5 5 volts The hairpin construction of the filament eliminates the effect of the magnetic *field due to the filament current by opposing* the fields of the two parallel sides The mass of the cathode renders temperature variations negligible, and the separate connection to the cathode sleeve eliminates the hum usually heard when alternating current is used and due to voltage drop along the filament

Theater Broadcasting.—The heart of the direct wire system used by Broadcast Central in New York City for the broadcasting of programs directly from theaters and other places is composed of three main arteries. In addition to these three arteries, there are nine additional permanent wires Various other net works of wires are tapped off and lead to the station from the main circuits This artery system enables Broadcast Central to reach many points and affords the radio audience a multitude of concerts, talks and plays. When a theatrical production is to be broadcast, a member of the program staff is detailed to review the play about a week in advance If the play has enough of its success in the songs and lines, it is considered a suitable radio subject. About two days before the broadcasting date a wire man installs the necessary backstage wire connections, which are of course, temporary in the case of the theaters On the afternoon of the date set for the performance the outside crew set up their equipment back stage The microphone is concealed in the footlights in most cases but may be suspended above the stage Everything is in readiness by the time the first of the audience arrives and the announcer then arrives and begins by introducing the theater audience to the radio audience. The announcer generally has a microphone just back of the scenes, so as to be in close touch with all that goes on Occasionally, the announcer is given a small dressing room, with interphone communication with the stage As soon as the performance is over, the microphones are removed Certain installations, such as that in St. Thomas's Church, are permanent.

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Ford cast the Liberty motor bearings centrifugally Bearings for Diesel engines were cast centrifugally by the Brooklyn Navy Yard, and these same bearings were babbitted centrifugally The most important application of this process at the present time is in making cast iron pipe The use of high temperature moulds has increased the life of the moulds used The sudden heating of a mold from room temperature to 1500 degrees Fahrenheit or higher subjects it to enormous stresses and results in checking or cracking of the mold in a short time. Linings of sand or various cements have also proved valuable.—*The Foundry*, 51 20, p. 825

Diesel engine manufacturers, even those whose motors have proved their complete success at sea are all carrying out much experimental work, with a view to developing new and improved types. After a period of prolonged experiments a new type of Diesel engine has been placed on the market which operates on the two-cycle principle and employs crank chamber compression, although the 200-horsepower four cylinder size is built alternatively with separate scavenging pumps The main point of importance in the design is the elimination of the injection air compressor A mechanically operated pump delivers the fuel to a special type of valve in the cylinder head This is automatic, so that there are no mechanically operated valves, while the fuel pump works at low pressure since the oil is delivered to the valves at the commencement of the compression stroke This engine, on trials has shown a fuel consumption of about 0 41 pound per brake horsepower hour —*Marine Engineering*, 28 10, pp 599-601

Steel casting.—Some investigators are of the firm opinion that the trend of the steel casting industry is gradually but surely toward making the bulk of steel castings in green sand and the remainder in cores that practically continuous molding and pouring will be the logical result of this trend and that the day is not far distant when both of these ends will be realized —*The Foundry*, 51 19, p 791

An oil fired crucible foundry furnace shown at the Hamburg convention of the German Foundrymen's Association attracted considerable attention owing to its advanced design Instead of the usual sheet, this furnace is enclosed in a perforated metal shell which, it is claimed has increased the radiating area at least 100 per cent This has a tendency to keep the air cool in the immediate vicinity of the furnace Oil and air for combustion enter the body of the furnace through the hollow trunnions on either side The compressed air is passed through an air chamber immediately below the melting chamber and is cooled while the air is heated to a certain extent before it enters the burner nozzle The oil stream is thrown against a strainer and atomized The flame from the burner enters the melting chamber around the plate supporting the crucible and rises around the crucible itself Hence metal in the bottom of the crucible melts first and gradually moves upward until the entire charge is melted

In the development of precision grinding machinery in central Europe the influence of American designs is apparent The widespread advantages to be derived by grinding were not appreciated fully before the world war but since that time the economic value of abrasive tools has been realized and grinding is steadily taking the place of other machining methods. In the United States, where engineers have had the benefit of years of experience, grinding machines have been developed to a high degree of perfection and European machine-tool builders, realizing this fact, have in many instances taken licenses for manufacturing tools after American designs. Plain and universal cylinder grinders, especially for tool room work, have been developed to quite an extent, while surface grinding practice is still in the development stage. Emery is used to some extent for grinding wheel manufacture on the continent, owing to the proximity of raw material supplies, but the artificial abrasives, carbide of silicon and artificial corundum, sometimes referred to as iron-free emery are used more extensively as their advantages are apparent. Europe is the birthplace of artificial abrasives, although they owe their greatest development to American genius.—*Abrasive Ind.*, 4:10, pp 283-85

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Traffic and the Law

(Continued from page 19)

Massachusetts, because of the smaller volume of traffic but it seems more likely that, as a general proposition, road conditions go down as traffic becomes less, making approximately the same maximum speeds appropriate all over the land Certainly it is very bad to have the published limit absolute in some regions and discretionary in others.

A point which eight states have recognized would well be given attention by all In overtaking a car ahead and in executing certain other maneuvers, the faster we move and the quicker we get it over with, the less of the road is it necessary for us to preempt. So Virginia requires that an illegal speed be maintained for an eighth of a mile before it becomes an offense Delaware, Massachusetts Minnesota and New Hampshire give the driver a quarter mile grace while Florida, Louisiana and Missouri allow him to burn up the road for a half mile before his speed becomes of itself a matter for police interference Where a similar provision is extended to the lower limits in towns, etc the distance allowed is usually smaller than that on the open road

Divergence in the lower limits is even wider and more confusing than in the general limit. A good deal of the terror is taken out of this situation however by the provision made in most states that such lower limit zones must be posted This provision however, is not universal and in its absence it is impossible for the visiting motorist to identify the restricted zones Some states regard the limits of an incorporated city or town as the defining element here Others attempt to define built up and 'closely built up regions in terms of the average distance between houses and to prescribe median and low speeds respectively therein Residence and business districts are another basis for the same thing in numerous states Practically all states have a very low limit somewhere from four to twelve miles for places which the writer defines in his own mind as traffic points' but there is no unanimity in their definition by the laws of the various states Grade crossings are sometimes included and sometimes not corners of city streets always highway intersections usually depend for their inclusion upon whether there is an unobstructed view on approaching them—which is a matter for the individual judgment of the driver curves and heavy grades are sometimes included specifically and sometimes left to the driver's judgment bridges enter the matter in some states schools usually and so on The number of states in which it becomes necessary for the automobilist to distinguish between corporate and unincorporated towns is no less than ten

Without any intent to criticize the enactments in question, or to deny that in many cases they may be necessary a few eccentric items may be lifted from the speed laws of some of the states. Tennessee's requirement of an absolute stop at grade crossings heads the list. Rather drastic is Arizona's limit of four miles for dams, bridges sharp curves steep grades etc. Colorado's geography makes it necessary for her to have four different figures for her mountain roads—20 18, 15 and 12—which apply according to the character of the road they are presumably posted, since so many cars from other states come to Colorado. Kansas calls for a speed of eight miles at railroad crossings and highway intersections in general and six miles at such points in incorporated towns When passing pedestrians or led animals on the roadway, the Mississippi driver has to slow to eight miles and he has to distinguish between narrow causeways and wide ones for the sake of a ten mile limit on the former New Jersey distinguishes between the car that runs *through* a road intersection at 15 miles per hour, and the one that turns the corner at 8 and you are supposed to restrain yourself to 15 in passing horses (but, presumably, not in overtaking horse drawn vehicles though the law does not make this exception) New Mexico has a similarly ambiguous provision about passing *all* other vehicles at 15 miles per hour North Dakota has a rule imposing 7½ miles per hour on the man who drives out of a side street into a main one Virginia restricts the man who is being overtaken to twenty, and the driver who passes a gathering of men or horses to ten Wisconsin has a limit of twelve in public parks

There is no point in multiplying examples We have said enough to indicate plainly that in every point pertaining to the conduct of an automobile, the laws of the several states vary widely Obviously this complicates

greatly the problem of insuring that the visiting motorist knows the law A few states, of which Connecticut is a conspicuous example, go a long way to meet the motorist in this regard When you enter the Nutmeg state over any main highway, you meet a large signboard apprising you of the fact, and summarizing those of the state's traffic laws which you most need to know It *tells* you, for instance, what to do about the standing trolley Pennsylvania is another commonwealth in which the interests of the 'foreign motorist are taken care of, as well as may be, by signboards There is but one lower speed limit in this state, fifteen miles per hour and all points at which or areas through which it applies are plainly posted Where the restricted zone is of any length, its end as well as its beginning is marked, so that one is in no doubt when to resume speed. But 21 of the 38 states, either explicitly or through the absence of any prohibition, permit local jurisdictions to set up speed limits and other traffic laws without reference to the state code and by no means is it the case that all these states require that the special rules be placarded

Of course, if you go into a strange state and plead ignorance as excuse for violating its motor code, the magistrate can, and doubtless will confront you with the fact that the traffic laws are published in pamphlet form and have been available for your inspection and study Strictly speaking this is true but after whiling away a train ride from New York to Boston in perusal of 38 of these little booklets we are not strongly impressed with the probabilities of learning to drive legally from them Space is lacking here to cite chapter and verse for this opinion which will be made the text of a future article

For the present we make but one further point. With few exceptions where local conditions are entirely eccentric and demand to be met with eccentric laws—as in the case of Colorado's mountain roads—the same regulations for the licensing equipment and driving of cars would work all over the country Such a uniform set of regulations would obviously be superior to the present barbarous divergence among the states The only reason why we have divergence in place of uniformity lies in the fact that 48 different legislatures in 48 different places have been passing laws, each without reference to what the others are doing Evidently this will lead to 48 ways of accomplishing the same result The conflict is not deliberate it has arisen automatically It will take however extreme deliberation plus cooperation raised to the nth power to replace conflict with uniformity Can it be done?

We believe it can In future articles of this series we shall survey the obstacles suggest means for overcoming them and try to make it clear why we believe that uniformity is possible and why it is of vital importance that it be attained

Cars of 1924

(*Continued from page 9*)

rough road because it makes little or no difference whether he takes them in or not. Of equal importance to improving the degree of comfort is the effect on the mechanics and body of the car itself So far no way has presented itself of making deliberate comparisons of the effect of low pressure air in preserving the car from developing rattles, creaks and mechanical depreciation, but there is no question about its being a tremendous factor This subject is of such interest that it is discussed at length in another portion of this issue (Page 25)

There are many innovations in minor details that are interesting but space does not permit of a complete exposition The Overland closed car is made with movable seat backs and cushions so the interior can be converted into a roomy sleeping compartment, making the car well adapted for touring and camping Then again many cars are now sold completely equipped with bumpers luggage carriers, rear stop signals windshield cleaners, shock absorbers, carburetor intake filter screens, thermostatic water circulation regulators, disc wheels, and numerous other devices that increase motoring comfort and that in past years had to be purchased separately and installed by the motorist. Summing up, in the writer's opinion, the purchaser has never before received such value for the money expended in a motor car purchase as is offered in most of the new models for the coming season Bodies have been greatly improved in appearance and even those fitted to low priced cars are graceful in outline and complete in appointments

Scientific American Digest

(Continued from page 64)

A new method of making patterns for large castings consists of building up a series of ribs with filling pieces fastened in between them, instead of building up elaborate patterns and core boxes The spaces between the skeleton ribs are filled with molding sand This method has been particularly successful in cheapening cost —*Am Machinist*, 59 15, pp 553-55

Rail steel reinforcing bars are sometimes referred to as being "re rolled" This term applied to rail steel is a misnomer In rolling rail steel bars, the rail is separated into three parts—the head, web and flange—and these parts are treated individually as billets and rolled into bars or other sections The rail steel bar is therefore the result of a continuation of the rolling process and is in no sense a "re rolled" product The objection to the term "re-rolled" is that it permits confusion of rail steel bars with bars re rolled from various kinds of scrap shell discard, etc

The effect of finishing scratches such as are left by the different machining processes used in machine shops for finishing crank shafts and other parts of machines subjected to alternating stresses have been studied out experimentally at the engineering laboratory of Oxford University England This modern practice as employed in automobile engineering is in itself an indication of the widely held view that surface finish has an appreciable effect upon the endurance of the metal This varies quite widely according to the shape of the grooves made by the finishing tool The results show that provided the variation in depth is small the increase of stress varies as the square root of the depth of the scratches divided by the radius of curvature of their point or inner extremity The actual reduction of strength is for the small scratches commonly met with however much less than is indicated by the mathematical theory —*Engineering*, 116 3015 pp 449 52

Railways

Cast steel freight car underframes—While the use of large steel castings in locomotive and steel passenger car construction has become quite general, the use of cast steel in freight car construction has practically been limited to the smaller units such as the truck *side frame* truck bolster etc For this reason the combination of center sills body bolsters etc in a one piece unit steel casting with ¾ and ⅞ inch sections as recently applied to a number of 80,000 pound capacity double sheathed box cars on the Southern Pacific Lines represents quite an achievement Underframes of this type have recently been applied to 10 new 80 000 pound capacity double sheathed box cars constructed for the Southern Pacific Lines The underframe is cast so as to form two center sills each of a Z section 9 inches high ¾ inch thick in the web and ⅞ inch thick through the flanges These are approximately 30 feet long between the inside flanges of the body bolsters Both the top and bottom flanges of these center sills are connected at intervals by cross members ¾ inch in thickness so that this section of the underframe is practically equivalent to a box girder section having an aggregate cross sectional area of 24 square inches —*Railway Rev*, 73 13 pp 447-48

Concrete ties of the Stent design, of which about 200 000 are in use on over a hundred miles of main track in India are of the block type each tie consisting of a pair of reinforced concrete blocks connected by a steel tie bar For a gage of 5 feet 6 inches 110-pound rails and 26 tons axle loads the blocks are 25 x 16½ inches on the base and 6½ inches thick reinforced by upper and lower sets of horizontal bars connected by stirrups Four plugs of treated wood inserted in the block serve to hold either drive spikes or screw spikes Each block weighs 166 pounds and the tie bar 16 pounds the total weight of tie with all fittings being about 350 pounds A concrete mix of 1 2 3½ is made with 2 parts hard silica quartzite and 3½ parts of ¼ to ¾ inch aggregate Only sufficient water is used to make the concrete flow when the form is shaken on a vibrating table After being left in the forms for twelve hours the ties are cured thirty days under water and then thirty days in air but are usually at least three months old before being laid Their life is estimated at 50 years. A few of the ties which have been in service for about nine years are said to be in as good condition as when laid —*Eng News-Record*, 91 13, p 511.

The Economic Position of Motor Transport

(*Continued from page 12*)

rail terminals—all very big factors in these days of small operating profits and high real estate values

Now, the principal advantage of the unit container adaptable to rail and road vehicles in the transportation of goods is the saving in labor costs by reduction in handling operations To quote from the paper by F S Gallagher, engineer of rolling stock, New York Central Lines we learn that "The saving in labor and time may be seen by noting, in detail, the number of times that less-than-carload lots of freight must be handled from the shipper to the consignee. Let us follow one package from start to destination First, it is carried from the packing room to the warehouse platform, second, from the warehouse platform to the wagon, by hand truck, third, from the hand truck into the wagon This is man handling The wagon then proceeds to the freight house, where at the platform occurs the next man handling The fourth man lift is from the wagon to the freight house platform, and the fifth, from the platform to the hand truck The individual package must be weighed, proper records made, and then taken into the car, making the sixth movement. A seventh handling is the stowing into the freight-car, after which is attached the seal, which is broken at destination The eighth handling is made by the unloader lifting the freight to the floor of the car for the hand trucker, the ninth, the hand trucker with the package stopping while record is being made of the shipment going off the car The trucker then carries this freight to a designated place in the freight house and it is left there The consignee is notified that his goods have arrived sends his wagon to the freight house, and notifies the delivery clerk. The delivery clerk points out the shipment to the hand trucker, who takes it to the wagon for loading which is the tenth handling When the package is delivered by the hand trucker to the wagon platform it is dumped at the tail gate of the wagon, making the eleventh handling and must be handled the twelfth time to place it into the wagon At the consignee's receiving platform the goods must be unloaded from the wagon, making the thirteenth time that this package has been handled" Coming from such a source and with such a bill of particulars, we must accept this narrative of absurdity at its face value Surely containers are needed!

Looking at the proposition strictly from a railroad standpoint, the unit container can be used to great advantage in such cases, as, for instance, where 1 c. l traffic loaded in a car at A is transferred into another car at B and into another at C, in which car the consignment eventually reaches its destination, D With a unit container the transfer at B and C could be accomplished by simply taking the container off one car and placing it on another As it is done now, each piece of goods has to be handled four times by the railroad company—and, of course, by man power

Other advantages of the unit container are the savings from loss and damage to goods, and the saving that can be made on many classes of goods in crating and packing This, in turn, permits of very material reduction in floor space required, which makes expansion of the business possible without further outlay in rental or property The advantages of the demountable body or flat over the conventional fixed-on types are principally savings in time, and savings in floor and street space For instance, the motor truck chassis' standing time can be reduced to a minimum by the scientific use of demountable equipment The best demonstration of this can be seen at Cincinnati where they use 225 bodies with only 15 motor truck chassis The voluntary standing line of these trucks for fifteen trips in eight hours is only about fifteen per cent of the total, an excellent showing for the demountable truck body

Referring to bodies and flats, it is thought that motor truck owners have failed to realize the possibilities of this kind of equipment, largely because they usually conclude that overhead cranes or tackle of some kind are necessary at loading platforms, in order to make the operation really effective. They have, therefore, evidently lost sight of the fact that with properly designed equipment wherever platform and chassis levels are about the same, no overhead cranes or special equipment are required, and, furthermore, that the bed or flat can remain on the chassis for any length of time desired, but is adapt-

able for removal where conditions permit. And now that we have found a way to transfer a flat or body from the ground to either truck chassis or flat car on rails with the power derived from the motor truck engine another disadvantage has been overcome

But, going back to the unit container used for interchange between electric and steam railways, and road vehicles, we have another story, and a problem requiring for its solution the closest cooperation of all transport agencies and all traders or merchants Where a balanced bulk load traffic in both directions can be had, unit container equipment holds out great possibilities for saving time and labor and thus a more economical movement than is possible by conventional methods. For instance, under a properly coordinated plant, a merchant with stores in several cities might use unit containers to great advantage. But unless the containers can be loaded in both directions the ultimate net saving will be very little and the venture may even turn out to be unprofitable, because the cost of transporting the empty is strictly waste effort. A container of light construction such as the duralumin one referred to is therefore highly desirable from this as well as other standpoints.

Our Abrams Investigation—IV

(*Continued from page 17*)

which are inherently faulty so that their outcome will be of absolutely no value Hence when the difficulties of preparing blood specimens were outlined to us by Dr Abrams personal representative we offered to make every necessary allowance for detrimental effects. We agreed to have an E R. A. man take the blood specimens himself, although we fully realized that such procedure somewhat weakened our test conditions

The object of such a test is to compare the electronic diagnosis with the known *facts* regarding the case Just as various E R A men tell us that they check up their electronic diagnosis time and again with clinical findings in order to have a confirmation of their findings so we intended to report the E. R. A diagnosis and the clinical diagnosis side by side Such a test would be interesting in many ways If we are to believe the E. R A. teachings at this time it would be as much of a test of the accuracy of the orthodox clinical findings as of the E R A

Under date of October 30th Dr Abrams replies to our request for blood diagnosis tests as follows

"Your suggestions to submit to blood tests as a conclusive procedure is fraught with many errors

Notably in the matter of reconciling the average clinical diagnosis with the electronic reactions The latter are essentially etiological diagnoses or diagnoses based on the causation of disease

"The average clinical diagnoses are based on the existence of a supposed lesion which is expected to be found at the autopsy The electronic reactions are diagnoses of processes, while the average clinical diagnoses are based on structural changes For this reason they cannot be expected to agree

"It is conceded that the average errors in clinical diagnoses under systems other than that of E R A vary from 50 to 90 per cent It is a quite different matter whether exam*inations are made voluntarily or subject to* test conditions The psychological factor is an enormous one, as shown in my journal

"I shall, on coming to New York submit to demonstrations that shall be just and scientific and before bodies who may seek such demonstrations for the sake of science and humanity so that I may prove the efficiency of the E R A"

The abstracts from Dr Abrams' letter explain themselves We gather (1) that the electronic and the clinical diagnoses are two entirely different things and therefore cannot be used together for comparison (2) that Dr Abrams does not care to undertake blood tests at this time because (3) such blood tests are opened to many errors (4) that Dr Abrams will submit to "demonstrations" here in New York before a scientific body In all our correspondence with Dr Abrams it is evident that he differentiates quite clearly between "demonstration" and "test," and that his cooperation is to take the form of "demonstrations" and not "tests." Dr Abrams, it will be noted calls attention to the psychological factor He indicates that when the E. R. A diagnostician is working under test conditions, he is at a decided disadvantage because of his anxiety regarding the outcome of the test. From time to time we have been warned against a skeptical turn of mind, for such a state of

TO THE MEDICAL PROFESSION

The SCIENTIFIC AMERICAN invites your interest and cooperation in its investigation of the ELECTRONIC REACTIONS OF ABRAMS We fully recognize the vast public interest in this highly controversial subject and we enter the investigation open-minded, unprejudiced and at the same time unwilling to either endorse or expose without first-hand proofs

The SCIENTIFIC AMERICAN will investigate on a thorough, scientific basis listen to the arguments and claims of both sides and conduct a series of tests under the Abrams methods with a critical examination of the apparatus Dr Abrams has placed at our disposal his services and his laboratories, and eminent members of all branches of the medical profession will assist in this sincere effort to give the public the truth on this subject

We shall be glad to have the benefit of your experiences and opinions This investigation was inaugurated in the October, 1923 issue, and its progress is being reported in each issue until its conclusion Should you wish to follow this investigation from the beginning we will be glad to enter your subscription for 1924, and mail you the October announcement with our compliments

SCIENTIFIC AMERICAN

mind on the part of the investigator has a decidedly detrimental influence on the reactions and consequently on the accuracy of the findings However we are certain that test conditions can be formulated in such a manner as to approach closely those of the usual informal diagnosis The E. R. A. diagnostician may take our specimens into his own laboratory and there, removed from any unfavorable influences work out his diagnosis in the manner in which he is most accustomed E R. A men have been reassured on this point time and again

We sincerely hope that Dr Abrams will see his way clear to undertake a series of tests for us He is the foremost electronic diagnostician He is the discoverer and the dean of the electronic practitioners His name is known to the public and carries conviction, so far as any test is concerned.

Recently we had the visit of Dr Jean du Plessis M D who has been quite close to Dr Abrams in the development of the electronic technique who is considered to be one of the foremost electronic diagnosticians to day, and who has done a great deal of research work of his own Dr du Plessis met several members of our committee and participated in an exchange of views regarding the claims made for electronic technique, as well as our past and present experiences with E. R A and our plans for the future Dr du Plessis urged that we arrange for tests with Dr Abrams, rather than continue to make tests with E R. A men in the field To this end, Dr du Plessis is exerting his good offices in an endeavor to have Dr Abrams submit to tests by us without further loss of valuable time

To those who have any doubts regarding the sincerity and seriousness of our Abrams investigation we gladly refer them to Dr du Plessis of Chicago Dr du Plessis found us fair and open minded anxious to learn all we could regarding the electronic reactions ready to make allowances for the delicate forces involved and willing to accept proofs far less significant than the fantastic claims made for everyday E R A work On our part, we found Dr du Plessis sincere, modest in his appraisal of E R A, sympathetic with our views, well versed in E R. A and capable of explaining its intricacies in a clear, positive, and understandable manner

Thanks to the kind offices of Dr du Plessis, the leading electronic societies are now cooperating with us for the purpose of formulating a definite set of claims which they are going to submit to our test Questionnaires are being sent to members of these societies, so that the E R A. claims can be boiled down to their very essentials filtered so as to remove the nonsensical features which have caused so much misunderstanding and harm to the cause, and presented to us in order that we may have something to work on Research committees are being formed by these societies for the purpose of undertaking our tests It is hoped that Dr Abrams himself will head the research committees.

Several weeks ago at this writing, we attended another demonstration of the electronic diagnosis. In this instance we were shown the touch method of diagnosis, which consists of running the tips of the fingers over the reagent's skin and detecting a roughness which is said to represent the electronic reactions We were taught how to proceed with a diagnosis of a blood specimen

Frankly we were enthused with the prospects of giving the reactions such a direct and, we hoped, convincing test The method of detection in this case seemed to offer more definite indication of the reactions than the usual percussing method or the sticking of a glass rod Nevertheless after trying for the better part of an afternoon to detect the reactions through the roughness of certain areas of the reagent we are free to confess that we failed If the reactions really gave rise to roughness, as claimed, they could not be demonstrated, even by a stretch of imagination to our mildest satisfaction We were keenly disappointed

In an early issue we shall make a formal report of what we saw at the Burnett Timken Research Laboratory at Alpine, N J where an extensive study of the electronic reactions has been under way for some time Rather extravagant use has been made of the Burnett Timken findings regarding the E. R A equipment, by electronic practitioners, and it was in order to weigh the importance of these findings that we spent an entire day with Dr Burnett and his research chief, Mr Hallberg

All of which is by way of stating once more that the electronic reactions, on which electronic technique is built, have not been demonstrated to us in a convincing manner,

thus far How can we, therefore be interested in remarkable cures and striking diagnoses, described in hundreds of letters which have poured into our editorial rooms when we have no proof of the existence of the delicate reactions on which the entire edifice rests?

The Future of the Air-Cooled Car

(*Continued from page 23*)

or ignition timing or poor mixture adjustment that would seriously interfere with proper and efficient cooling by air This cannot be considered seriously as an objection, however because no engine is supposed to operate under conditions of insufficient oiling or incomplete carburetion and any engine which would give an early warning of either of these unfavorable factors should be preferable to one that would continue to operate inefficiently and perhaps to the detriment of its mechanism As far as uniform cooling is concerned a blower-cooled engine will function as well as any water cooled power plant under the same conditions of speed road or gradient

There can be no more question regarding the suitability of air cooled engines for certain classes of aircraft than there is about their successful application in automobiles and motorcycles The writer had personal experience during the late war with many hundred air cooled engines of both the rotary and fixed crank types that were operated under his personal supervision in exacting training work and absolutely no trouble was experienced in cooling them even though they were run under full load and speed conditions most of the time S D Heron of the Society of Automotive Engineers a well known authority on air cooling reports the satisfactory cooling of an eight inch bore by ten inch stroke cylinder by direct air cooling and the development in a smaller air cooled cylinder of 138 pounds per square inch brake mean effective pressure which is decidedly more than that developed by any standard automobile engine A 60 horsepower three-cylinder radial air cooled engine having aluminum cylinders with liners as previously described was given a break-down or endurance test and stood up beyond any reasonable expectations for water cooled aviation engines even though it showed a brake mean effective pressure of 125 pounds per square inch which compares very well to the 90 to 110 pounds found in average automobile engines

Direct air-cooled engines have been operated from the Atlantic to the Pacific far north and far south through Death Valley and across the American desert in torrid heat and arctic cold and the splendid performance of the new types has demonstrated beyond doubt that air-cooling is desirable and practical and in my opinion on the eve of greater application in automobiles

Floating the Car on Oil

(*Continued from page 24*)

it is most needed Incidentally roaring the motor does not accomplish the desired purpose as well as a moderate speed with a retarded spark

On cold winter mornings a motor that has been standing all night in an unheated garage may often be started by pouring warm water from a tea kettle on the intake manifold or still better, on a rag wrapped around the carburetor The added heat makes a decided difference in the amount of gasoline that will be vaporized even if the parts are not heated very warm to the touch

Running in weather that is very much below the freezing temperature cools the engine too much not only for most efficient operation but for the complete consumption of the fuel unless the radiator hood is used It should be remembered that an internal combustion motor operates at its best efficiency at temperatures as high as the boiling temperature of water and one reason a radiator is not made small enough to keep the water near the boiling heat is that the water would have to be replenished too often for convenience When the engine is too cool the fuel is poorly or partially vaporized and much of it finds its way past the rings to dilute the crankcase supply

Another trouble that follows in the train of incomplete vaporization of fuel in cold weather is an accumulation of water in the crankcase due to that fact that when a mixture of gasoline vapor and water is fired water is one of the by products This water before the engine is heated up gets into the crankcase where it may freeze in a layer beneath the level of the oil which floats on it, and break the oil pump or make it inoperative. Incidentally, it may make an

emulsion with the oil and result in scored cylinder walls. Probably the safest and easiest way to get around this possibility is to drain the crankcase every 400 or 500 miles in winter

One very important thing is to drain the crankcase only after a run, when the motor and the oil are thoroughly heated up This is not merely for the purpose of getting rid of all of the oil by losing it when it is at a free running heat, but for the much more important reason that all the fine particles of metal which have been worn from bearings as well as the sand that has clung to the cylinder bloc casting and worked loose will then pass out with the oil instead of settling and remaining each time to provide an accumulation of excellent abrasive where the opposite effect is sought.

Many bearings have been burned out in almost a moment by starting an engine in cold weather when the oil is very viscous and will not flow to the bearings in time to lubricate them It takes only a small change in temperature to double the time necessary for a given oil to flow through a small passage and for this reason the motor should be dealt with very gently for a few moments

At such times the differential and the transmission gears also will merely break a channel in a sump of oil which has become practically solid and since gears seldom develop heat enough to melt down the walls of oil thus created in time there is nothing to save them severe damage In cold weather therefore it is advisable to mix one part of motor oil with two of gear oil in order to bring the gear oil to the right degree of viscosity For the chassis winter lubrication calls for a lighter cup grease for grease cups and the same grade of oil used in the motor for the oil cups At this time it will be necessary to keep better watch of the various oiling places on the chassis, since the cold weather may render them ineffective at any time

With the Men Who Fly—III.

(Continued from page 27)

along the line of the wind In the most recent designs hydrogen mains fuel pumps and water pumps are incorporated in the structure together with elevators for passengers and baggage

Of course the entire design of an airship is an effort to secure safety and refinements and improvements are constantly being introduced Skilled handling is required and in time crews will become as skilled in handling a gigantic dirigible as the officers and crew of ocean liners are in handling the Leviathan In the history of engineering in general and transportation in particular no early disasters have prevented the final introduction of any invention which had an economic service to render

And in favor of the airship there are distinct economic factors Given a steamship and an airship of equal gross weight and equal speed the airship will require only one tenth the horsepower of the former Here is the basic reason why more speed can be obtained The surplus power of the dirigible can be used not to economize on fuel but to increase speed This is the airship s real reason for existence A speed of 60 m p h is practically impossible for a steamer but is an easy matter to attain for a dirigible 83 miles an hour has been reached and 100 miles an hour is simply a matter of design Captain Anton Heinen German consultant in the construction of the "ZR 1" estimates, for example, that the time of a voyage from San Francisco to New Zealand could be cut from 22 days to 6 days.

The not inconsiderable carrying capacity of the dirigible, added to this tremendous saving of time will ultimately give it a place in ocean travel on a vast scale. But the initial expenditure in the purchase of equipment and in base organization is enormous. In running charges fuel itself would be an inconsiderable item but repairs, replacements the use of expensive helium gas, the costly process of learning how to run a dirigible line, and the possibility of a low volume of traffic at the start, do not make it probable that operations would be immediately successful from a financial point of view The formation of an airship line, while entirely feasible and promising must be undertaken with gigantic capital, with men of enormous financial strength who can take a long view of matters and not be discouraged by the loss of money in the first two or three years of operation.

Airships or Airplanes?

Controversy often arises over the question as to whether dirigibles or airplanes will ultimately be the vehicle of air transportation The answer is that the two have entirely different spheres of action, and that one type of aircraft cannot trespass on the work of the other from the very character of the basic principles in the construction of each type The airplane spells speed without practical limit, but has a very definite limitation in size range and carrying capacity The dirigible can never hope to attain anything like maximum airplane speeds, but there is no practical limit to its size or carrying capacity and the larger it is the more economical it becomes.

This admits of a ready explanation. If a small airplane is taken and duplicated on geometrically similar lines but a much larger scale its total lift will increase as the square of the dimensions, while its structural weight will increase theoretically as the cube of the dimensions. Hence as the airplane increases in size its structure will bear a larger ratio to the total weight, although this effect can be minimized by improved construction in large size airplanes, and its useful carrying capacity will diminish as a percentage of the whole There is, therefore, quite a definite limit to the useful size and range of an airplane. At the same time the difficulties in landing a huge machine increase very considerably

With the airship the situation is different. Its volume of gas and hence its lifting capacity increases as the cube of the dimensions. Its structural weight remains the same or becomes even a diminishing percentage of the whole weight, while the power required depends mainly on the surface area and therefore on the square of the dimensions. A large dirigible, therefore, requires less fuel than a smaller one for the same speed, and while the percentage of available load may not increase the percentage of commercial pay load increases indefinitely with size.

Economically speaking therefore, the right direction is toward comparatively small airplanes and enormously large dirigibles.

But when it comes to speed, the dirigible, while it compares more than favorably with ships, or trains, must of necessity lag far behind the airplane This is due to a remarkable and often unrecognized principle of the airplane No matter what the speed of an airplane is, the pull required to propel it through the air remains the same fraction of its total weight So that to carry an airplane over a given distance the fuel used will be substantially the same whether it is flying fast or slow We may travel very fast in a plane between two points and use up fuel very fast or slowly and use fuel more slowly But the total quantity of fuel used between the two points will be the same Hence it is economically possible to drive the airplane at any speed we desire subject to such limitations as landing speed and the physical endurance of the pilot

In the dirigible, however, the same law of resistance applies as in the propulsion of ships Namely the pull increases as the square of the velocity and the horsepower as the cube Just as it is impossible to drive the Leviathan through the water at 60 miles an hour without the use of such gigantic engines that no cargo or passenger capacity is left, so with the dirigible it is impossible to go beyond a certain speed without destroying all commercial possibilities

No matter what temporary departures from basic principles there may be in the use of the two types of aircraft, ultimately fundamental laws will win out. The airplane will be supreme for comparatively short hauls of between 500 and 1200 miles, it will be comparatively small and will carry business men in a hurry mail and express matter of small bulk The airship will be used for long hauls between 1200 and 5000 miles or more, it will have an enormously greater carrying capacity and will ultimately carry real freight in addition to mail and passengers. It will be supreme for transoceanic services and possibly for transcontinental work, although here it may meet with strenuous airplane competition. Or a combination system may come into being where airplanes will act as feeders to the main dirigible lines.

Hazardous as it is to make any prophecies in the matter, we can safely say that no type will supersede the other, that one will be used in conjunction with the other.

But enough has been said in this series of articles to show that the commercial possibilities of both airships and airplanes are enormous, that they are even now ready for application on a vast scale, and that we are on the eve of a revolution in the technique of air transportation both over land and sea.

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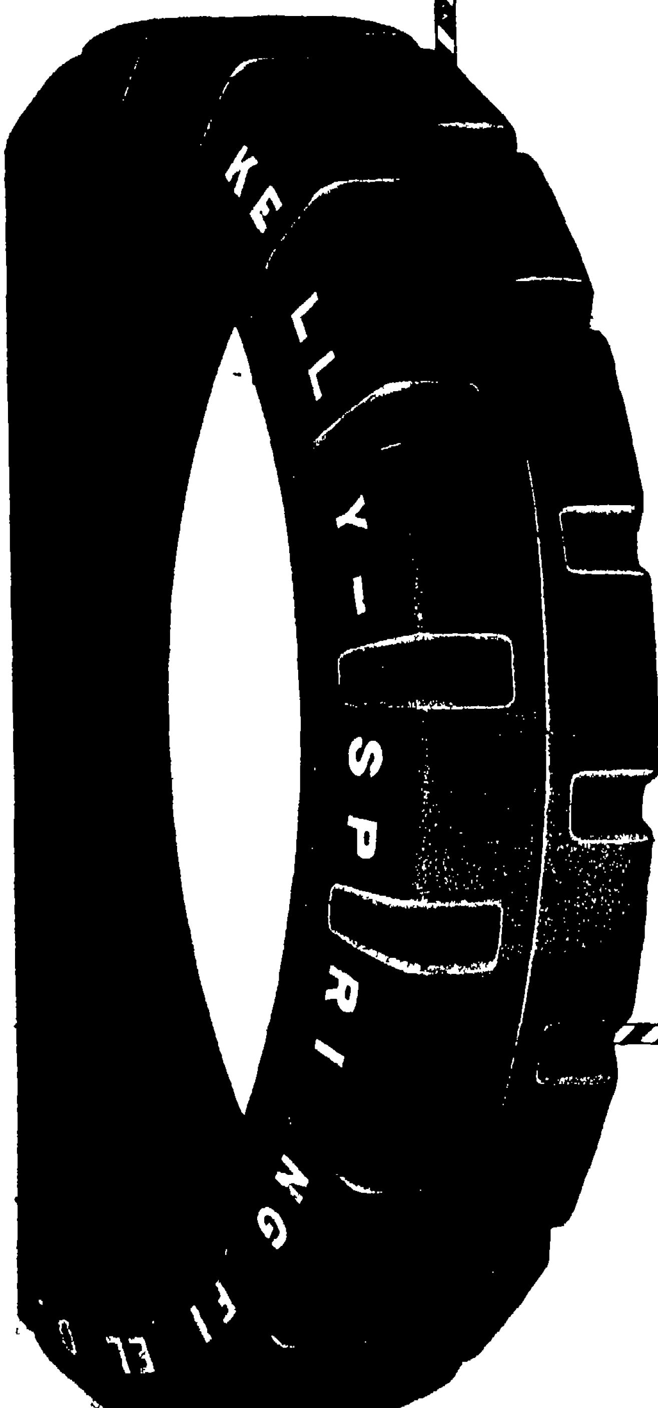

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SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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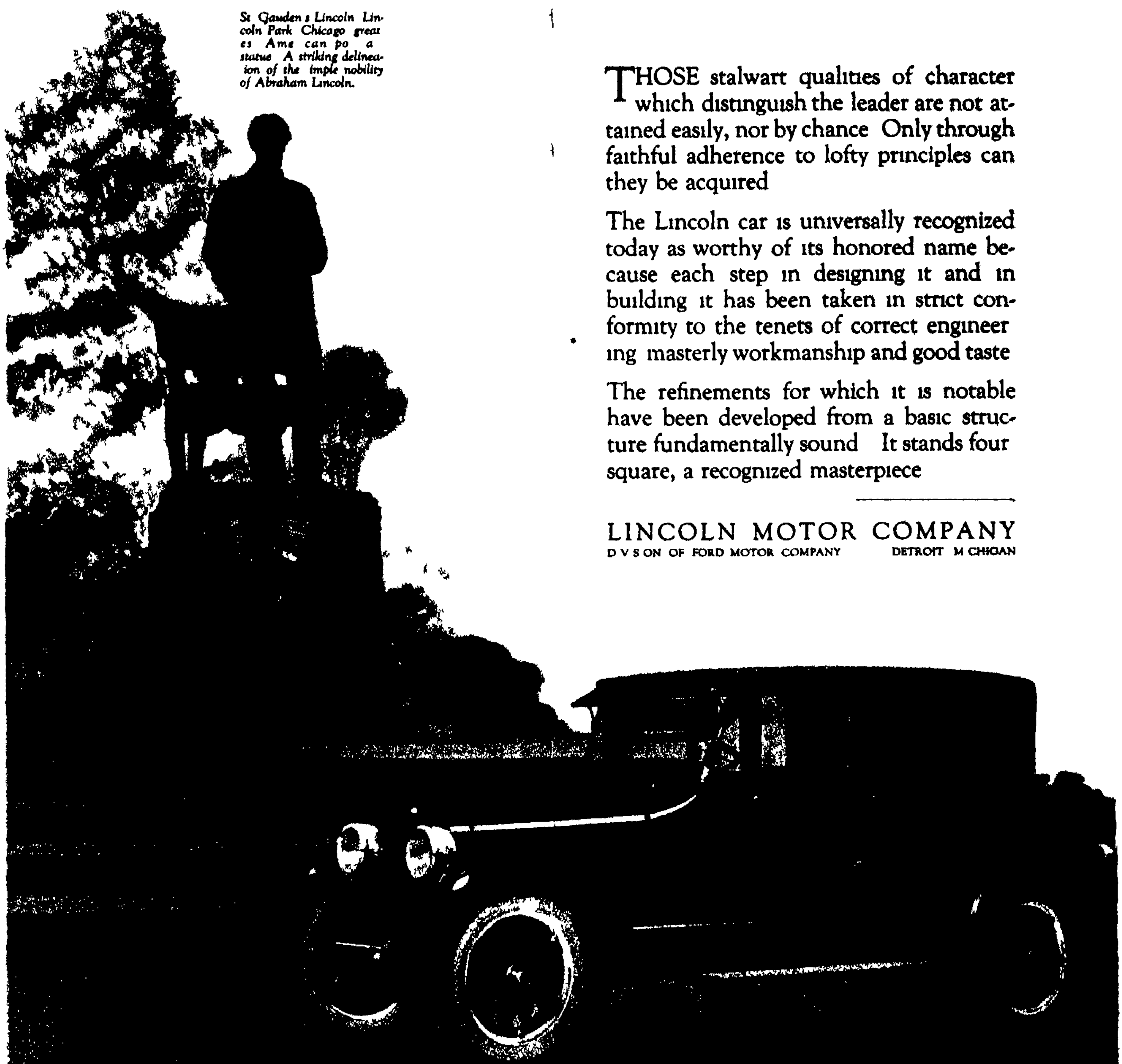
IN THE NAVIGATING ROOM OF THE U. S. NAVY DIRIGIBLE SHENANDOAH [See page 8[illegible]]

Scientific American Publishing Co., Munn & Co., New York

MASTERPIECES



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With the Editors

ONE of the functions of the editorial staff of any journal of standing is the answering of inquiries Between the questions asked of a given editor, and the field which his paper covers, there exists a distinct relation The magazine of detective-story fiction is asked how to become a detective and how to catch a suspected wrong doer, the journal of bee culture is asked questions on keeping bees and marketing honey We ourselves are unable to define our field any more closely than by use of the word "science" with more or less emphasis on the adjective "applied," are asked questions about every serious and near serious topic under the sun

HOW can I keep the ground water from seeping through the cement of my cellar? What is the cause of the lateral drift of projectiles? What book would you recommend for an elementary study of the elliptic functions? What is the present manufacturing cost of helium under the best conditions? Does the divining rod really work? Will a packing of sand conduct sound? Is there in general use in the United States a welding process notably superior to those current in England? How much heat and light does the earth receive from Jupiter? How can I bore holes in glass without breaking it? What is the difference between the several species of horsepower which one finds quoted, and how is each calculated? How many prime numbers are there and is there any simple factor test for large numbers? What are the formulæ for the paste and the electrolyte in a storage battery? What is the highest instantaneous speed ever developed by an airplane?

MOST of the people who ask us questions like these realize that we can't have the answers on our finger tips and are content to wait while we dig them up Others are not so easy to deal with They call us up to propound a question which their own search and that of their librarian has failed to settle and they are highly indignant when we do not give the answer instanter The explanation that it has to be looked up, or that the member of the staff who could answer it without search is not at his desk is rejected scornfully and the voice on the other end of the wire expresses more or less explicitly its owner's feeling that we who cannot answer out of our stored wisdom any question which he could possibly propound, in any department of science whatever are decidedly out of place on the editorial staff of the SCIENTIFIC AMERICAN This is very gratifying in so far as it reflects the esteem in which we collectively, are held but it is trying upon the individual editorial disposition

WE have another grievance against some of those who query us Most of them have significant questions on topics in which they are seriously interested But there is always an appreciable residuum who ask trifling questions on trifling subjects Every query editor has a dozen or so of these good old chestnuts, which come up three times a week, as regularly as the clock runs We have had as many as five of them in one letter

DID the "Titanic" reach the bottom or does she swing suspended at an intermediate depth? If a bullet is shot from the back of a moving train, at a speed equal to that of the train, what happens to it? Who invented the automobile? If an explosion occurs with no person in earshot is there any sound? How do we explain the cutting up of an eight inch square into pieces that fit together into two rectangles with an apparent aggregate area of 65 square inches? All of these as well as numerous others which we could cite we have answered in and out of print on numerous occasions but they keep right on coming Their effect upon our time is serious, and on our temper even worse

WHILE answering questions is part of our job and on the whole we enjoy it It constitutes a very real part of our service to our readers But we hope for the millennium in which no querist will out of idle curiosity ask us trivial and hackneyed questions and in which every querist will first make a reasonable effort to find his answer for himself and will then realize that his inability to find it at all is good indication that we can't give it offhand If all these things would come true, the answering of our reader's questions would be a continual pleasure instead of a pleasure mixed with periodic pain

OF less spectacular interest than our psychic and *Abrams investigations* but no doubt of greater practical value is our present campaign for the improvement of highway traffic conditions, which is represented in this issue by the article entitled One Law vs Forty Eight This campaign has for its purpose the study of traffic laws and regulations highway facilities in various parts of the country the traffic congestion in cities grade crossings and other features which concern every one whether an automobile driver or not What with millions of passenger cars in operation and hundreds of thousands of motor trucks and buses the highways play a most important role in our national life *Of late the number of accidents* have been such as to attract undue attention and it is evident that something must be done to make highway traffic safer than it is today And if nothing is done the existing difficulties will by no means right themselves, but rather will keep on augmenting So, something must be done—and done quickly

NOW this highway traffic matter varies from one part of the country to another due to local conditions and local laws Nevertheless it must be considered in terms of the entire country for it is a national problem and not purely a local one *It calls for an interchange of ideas* It is as necessary to hear from the motorist in California as it is to hear from the truck driver in New York Indeed we want to hear from everybody regarding existing difficulties in highway transport and highway travel as well as any ideas which may be put forward by way of helping solve the existing problems Let us put all our views and ideas together Get in touch with us by addressing your letter to the Highway Traffic Editor

IF the Abrams investigation now being conducted by this journal has accomplished nothing else as the result of four months of patient and unrelenting investigation it has at least boiled down the claims of the E R A (Electronic Reactions of Abrams) practitioners to a very modest basis as compared with the elaborate if not fantastic claims originally made for this new technique Page 87 of this issue tells the story to date

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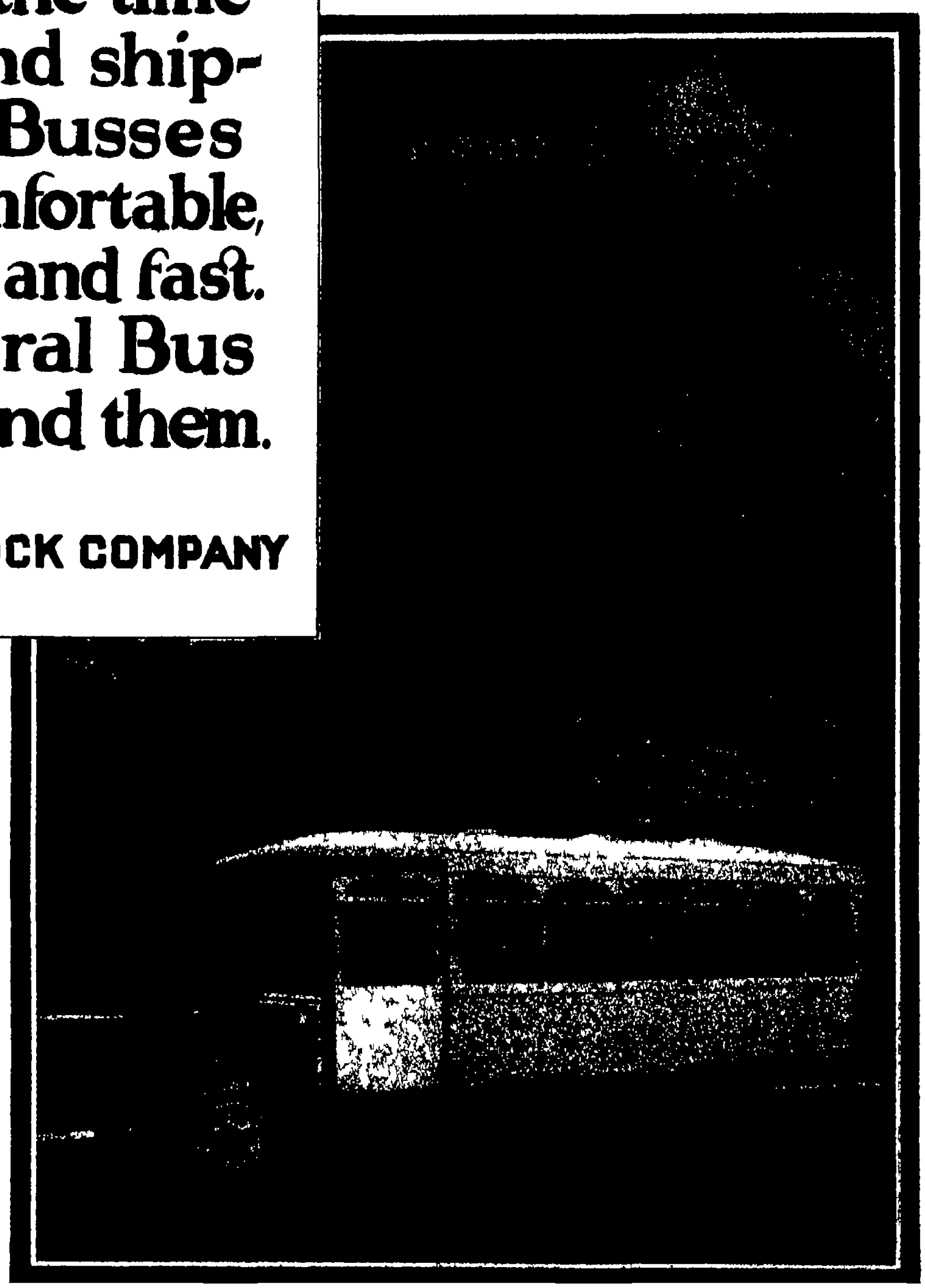


EIGHTIETH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, FEBRUARY, 1924

The Oldest Eggs in the World

A FEW months ago a cablegram from China announced perhaps the most curious find ever made in exploration. Roy Chapman Andrews was the leader of the Third Asiatic Expedition of the American Museum of Natural History. The American Asiatic Association, and *Asia Magazine*. It is through the courtesy of *Asia Magazine* that we are enabled to present, largely in Mr Andrews' own words, the interesting facts of his discovery of a nest of dinosaur eggs.

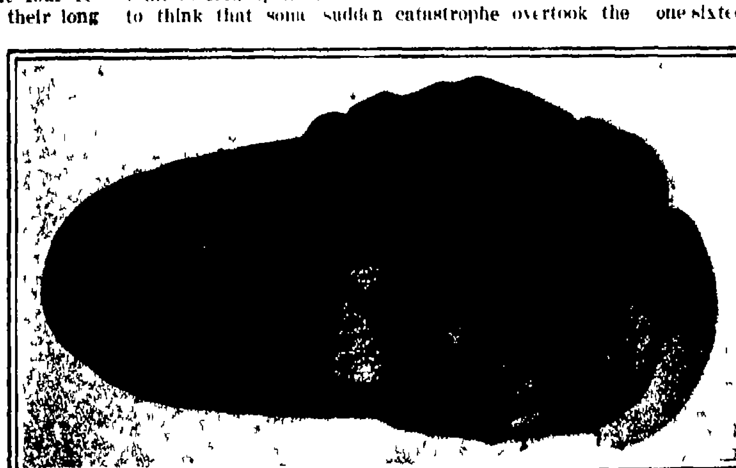
A dinosaur was an ugly brute and would alarm even a grown up, if we should see him stalking with the thin hatchet face, elongated neck, bony frame and thick tail. Even in restoration it is an awe-inspiring monster which no artist could evolve even from a diseased brain—the reality is much more horrible. Ten million years ago this strange creature existed on the edge of the shallow basin of Mongolia and slowly waddled down and settled into the sand and in a hollow left a number of eggs which fortunately for us, were never hatched by the heat of the sun.

Of course dinosaurs have been found in other parts of the world, but there has never been anything so spectacular in the whole history of paleontology as the discovery of these remarkable eggs. It is probable that the dinosaur migrated millions and millions of years ago through Siberia and across the land bridge to America, and spread inland to its western coast where the type grew to an enormous size and developed horns. Heretofore we have always thought that the fossil bones of *Triceratops* originated here. They appeared completely developed in the cretaceous rocks and gave no clue to their family tree. Mr Andrews says that it was on a brilliant day in midsummer ten million years after the reptile had made its nest in the sandy hollow, that the expedition pitched their tents on the rim of a great depression just below where the eggs were laid. Hundreds of feet of earth had drifted over them through the ages and by the action of wind, frost and rain leaving them half exposed. Some showed only bits of broken shell but four remained intact. They were no longer white their long entombment had changed them to a delicate brown. The configuration of the country was vastly different from when the dinosaur laid the eggs. Of course the climate had altered enormously in the immense period intervening between the time the eggs were laid and when they were discovered.

Mr Andrews, in his story in *Asia Magazine*, describes most interestingly the actual discovery of the fossil remains. It seems that the photographer wandered off to look at some earth ovens left by Mongols and much to his surprise he found that they were at the edge of a plateau that fell sharply away into a great basin. He decided to spend five minutes in looking for fossils before returning to the automobiles. Almost at once he discovered a small white skull, which was afterwards identified as an ancestor of the great horned dinosaur of America. The locality was worked over in the usual way and one of the party reported that he was sure he had found fossil eggs. This seemed so remarkable that the matter was turned over as a joke but nevertheless it was agreed that they walk to where the alleged eggs had been discovered. Then their indifference suddenly evaporated for they realized that they were looking at the first dinosaur eggs ever seen by a human being. Mr Andrews says "We could hardly believe our eyes, but, even though we tried to account for them in every possible way as geological phenomena there was no shadow of doubt that they really were eggs. That they must be those of a dinosaur we felt certain. True enough it never was known before that dinosaurs did lay eggs but since most modern reptiles are oviparous, it was considered probable that their ancient ancestors followed this method of reproduction. Nevertheless, although hundreds of skulls and skeletons of dinosaurs had been discovered in various parts of the world, never had an egg been brought to light.

"These eggs could not be those of a bird. No birds are known from the Lower Cretaceous the geological horizon in which the eggs were found and all the Jurassic and Upper Cretaceous birds were much too small to have laid eggs of this size. The elongate shape of the eggs is distinctly reptilian. A bird's egg usually is much larger at one end than at the other because it is deposited in a nest from which it might roll out unless it revolved on its point. Reptile eggs which often are buried in the earth or sand usually are elongate and similar in shape to the specimens that we found. These eggs were in a great deposit full of dinosaur skeletons and containing, so far as we could discover, no remains of other animals or of birds.

"Three of the eggs lay in a cluster and evidently were in the exact spot where they had been deposited by the dinosaur. The broken shells of several others were partially embedded in the rock. Just under a low sandstone shelf beside which they were lying, we could see the projecting ends of two others. While all the members of the Expedition were on their hands and knees about those ten-million-year-old eggs, George Olsen began to scrape away the loose rock on the summit of the shelf and to our amazement he uncovered the skeleton of a small dinosaur lying eight or ten inches above the eggs. Was it the reptile that had laid the eggs or was it a predatory dinosaur that had come to feed upon them? We cannot tell but we like to think that some sudden catastrophe overtook the actual egg layer, while on a visit to its nest.



A "close-up" of a Dinosaur egg perhaps ten million years old

"We believe that the eggs were buried in fine silt or sand, which would be peculiarly suitable for the preservation of delicate objects. This place may have been low ground, over which the waters of a river would spread during flood time, but running stream action could not have taken place here or the eggs would have been rolled about separated and inevitably broken. Personally I believe that they were buried in light sediment carried over them by the wind. The first specimens found by George Olsen are about eight inches in length and seven inches in circumference. They are rather more elongate and flattened than is usual in the case of modern reptile eggs and very much longer than the eggs of any known bird.

Roy Chapman Andrews examining one of the eggs

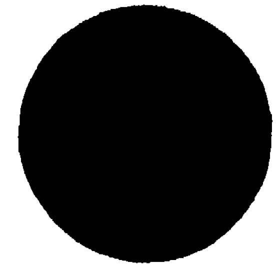
"The preservation is beautiful. Some of the eggs have been crushed but the pebbled surface of the shells is as perfect as if the eggs had been laid yesterday instead of ten million years ago. The shells are about one sixteenth of an inch thick and probably were hard and not membranous. Fine sand has filtered through breaks and the interior of all the eggs is solid sandstone. In the photographs the bits of broken shell partially embedded in the rock are plainly to be seen, and it needs no stretch of imagination to realize that the objects pictured are really eggs. In fact we tried our best to think of any geological phenomena that could have produced a similar result but try as we would we could never get away from the fact that 'eggs is eggs' and that these were laid by a dinosaur."

A few days after the first discovery five eggs were found in a cluster. Altogether 25 eggs were taken out and not all of them have been brought to this country as yet. Further examinations show that there were a number of species of dinosaur eggs and most interesting of all was the fact that in several of the eggs that had been broken in half there could be plainly detected the delicate bone of the embryonic dinosaurs. Never before in the history of science has it been possible to study paleoembryology. Baby dinosaurs that had probably been hatched only a few weeks and others in all stages of growth up to the adults ten feet long were also discovered as fossil remains. Certainly Mr Andrews has to be congratulated on the most remarkable discovery ever made in the history of paleoembryology.

The Romance of the Lock

Its Development, and the Means Employed to Beat It, From the Earliest Days

By Edward H Smith



LOVE and larceny laugh at locksmiths. There may be an alliterative overburden in the paraphrase but there is no divagation from truth. Whether passion or cunning shall laugh last—Eros or Autolykos—who shall say? For the present however the god of theft laughs longer louder and better. The barriers his children break are the substantial ones less fabulous than love's but more rewarding. We may neglect this mirth of lovers and consider that of thieves.

To trace this ribaldry to its origins might lead us into too deep and distant peregrinations; besides there is enough to engage our attention in the present and the immediate past.

Late in the hot morning of September 25 1865, two men drove into the historic town of Concord Mass, in an old phaeton behind a sorrel mare drew up before the Concord National Bank and blithely committed one of the truly monumental pieces of lock defying. Their names were Langdon W Moore—of whom previous mention—and Harry Howard. The evil that they did has as you see, lived after them. Indeed the crime they committed so ably and openly in the white sunlight of that autumnal noon may be said to constitute one of the decisive engagements between the makers and breakers of locks and it is therefore an important page from the endless story of burglary.

The Concord National Bank, an old and conservative institution, then considered itself well protected with a chilled iron vault whose entrance was guarded by double doors of the same material and an interior burglar proof chest of special construction. Five keys were required to release and open the outer door of the vault; two opened the inner doors and two more were needed to get into the chest. The locks were of the kind called warded, a term which will be explained later. They were of most complicated design and finest English manufacture—a detail which was then considered distinctive and reassuring, albeit English locks sprang into sudden disrepute immediately after the ensuing crime and continue to this day to be regarded with slight esteem in America.

Langdon Moore who lived in the neighboring village of Natick noticed while visiting in Concord one day that the cashier of the Concord Bank locked up his institution at noon and went home to his luncheon remaining away until half past 1 or 2 o'clock. On this chance observation the great robbery was founded. Moore the idea of the burglary forming in his mind returned to Concord and observed the habits of the other business people along the main street near the bank. He saw that they, too went home for the midday meal at 12 and remained absent at least an hour leaving their shops and offices locked or in charge of solitary clerks. The business center of Concord was thus almost deserted for this interval. The circumstance spelled opportunity.

Moore who divided his time between the farm at Natick where he was accepted as a respectable gentleman and New York where he was already a noted member of the professional underworld with the false name of Charlie Adams had never before robbed a bank—an oversight for which he made amends later on becoming before his death one of the most celebrated of our older vaultmen. In spite of his then inexperience he saw what the officers of the bank had failed to realize namely that whatever can be locked by one man may be unlocked by another if he have the genius and the persistence for the essay. He summoned to his aid the man called Howard really Henry Hauck an errant German locksmith turned burglar. To Hauck he explained his plan and disclosed the details of the bank's equipment which he had gathered by visiting the institution to get money changed and to negotiate a purchase of bonds.

A few nights after the arrival of his confederate Adams went to the bank and examined the lock on the street door. He inserted a blank key of a size to fit the keyhole having first taken the trouble to coat the key lightly with wax. By turning the blank against the inner mechanism of the lock the wards naturally impressed their position or outlines on the soft wax and this map of the "works" was carried away. Howard fashioned the key to fit and the prospective burglars returned to the bank on a subsequent evening to have their try. Their key did not work so Howard got a ladder and by its help reached the rear windows of the bank which I have neglected to record was situated on the second floor of the building over the offices of a real estate firm.

Descending to the street door, Howard removed the bolts and took off the lock. It was found that a special metal tongue prevented the opening of the lock with the improvised key. This bit of metal was filed away and the lock put back into position. Now the key did the work. The first stage of the burglary was accomplished.

On the same night the plotters took an impression of the lock on the second floor, which fastened the door leading into the banking rooms. A second key was improvised to suit this pattern. On a convenient dark night the scheming pair returned opened the street door with their first key, found that their second key worked the lock of the door upstairs and so had won their way to the vault. But here they met decided obstacles. The five keyholes of the outer door were of no ordinary design and attempts to make impressions through them were fruitless.

But the resourceful Moore was not foiled. He left his confederate on the farm at Natick and went traveling in quest of the American agents for the English vaults used in the Concord Bank. He found them in Boston, with one of the doors of the five keys in the showroom for exhibition purposes. Moore plausibly represented himself as a broker and dealer in securities with the result that the agent carefully explained the workings of the locks showed him and let him use the keys outlined the special tricks that foiled burglars and gave Moore every shred of information he needed.

As a result of this visit five keys were made from Moore's drawings and descriptions. With these the two men returned to the bank at night let themselves in with their two keys and tried their new openers on the vault. None fitted but by means of wax and pressure the burglars were able to determine their errors and correct them. After several subsequent visits they had their keys in proper shape and the outer doors of the vault were opened.

Moore had of course, also learned all about the inner door on his visit to the vault agent and Hauck was provided with approximate keys to fit the two locks encountered here. Once more the process of repeated trial and error brought success and the men stood in the presence of the chest. They found that the first of its two locks merely held a guard or apron over the true keyhole. They found little difficulty in making a key to open the guard, but once they had accomplished this they met a new and apparently insuperable obstacle. The lock and key of the chest were evidently of special and exclusive design. No impression could be got and there was no hope of discovering the secret from the maker. The burglars decided that they would have to do their job at night and win their way into the chest with powder a course they were loath to take because of its dangers. Moore had set his heart upon a mysterious noonday burglary—noiseless swift and inexplicable. He understood that no one would notice him and his sorrel mare on the country roads in the middle of the day. No one would remark his coming or going at such an hour, whereas a flight by night from an alarmed town might be obvious indeed, especially if it ended, as was intended at a farmhouse only a few miles away.

Accordingly Moore went back to the bank once more to buy a few bonds and carefully watched the cashier open the vault. The preliminaries interested him very little, but when the banker reached the chest Moore almost leaped with excitement for he saw the cashier reach up to a dusty high shelf and take from its hiding place the mysterious key that opened the strange lock of the money box. The burglar bought the bonds, chatted with the banker and made excuses to stay long enough to see the chest relocked and the key furtively slipped back into its niche.

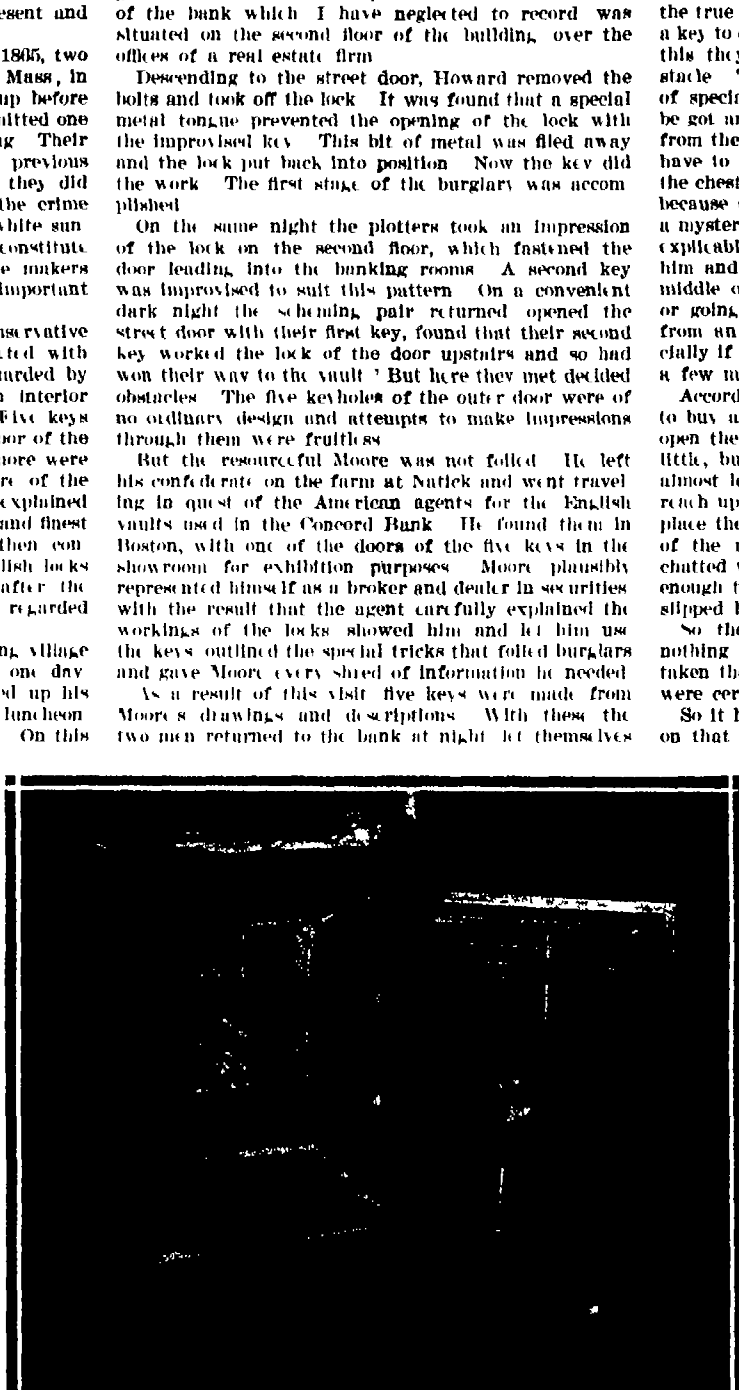
So the robbery was concluded. The plotters had nothing to do but commit it. Their preparations had taken them between five and six months, but now they were certain of their prey.

So it happened that the two men drove into Concord on that September day just before noon, stopped the old sorrel mare at the curb opposite the bank watched the cashier lock up and go home for his "dinner" and forthwith robbed the bank.

Hauck remained in the phaeton reading some papers which he held before his face to shield it from passers-by. Moore, armed with ten keys and a meal sack walked across the street, opened the street door, locked it after him ascended to the banking rooms, unlocked the door there applied the five keys of the outer vault door in their proper sequence, opened the inner door similarly, unfastened the guard before the keyhole of the chest took the vital key from its shelf, opened the chest and loaded the contents into his bag. He then relocked the whole defensive mechanism taking the chest key with him, and left the building.

Hauck and Moore drove quickly back to the farm at Natick, divided and buried the loot, turned their sweaty mare loose to roll in the dust of the feedlot and were ostentatiously busy at their workaday tasks within two hours after the astounding bit of lock beating they had performed.

When the cashier returned from his luncheon and found the street door unlocked he was suspicious. When he opened the vault and found the chest key gone he was seized with alarm. Still he could not be sure there had been a robbery. Boston police were summoned and



The combination dial has been knocked off and is lying on top of the safe, but the extra bolts of the re-locker at top and bottom of the safe door went into action when the regular safe bolts were released, thus saving the contents

A safe that was attacked without success by the burglar

the president of the bank called home from Albany with the duplicate key to the chest. He could not arrive before the next morning. Then all doubt died in a flood of briny disclosure. There had been a burglary, past doubt. Three hundred and fifty thousand dollars worth of negotiable bonds were gone.

This sensational and historic incident had as much influence as any single happening upon the rapid discarding of key guarded safes in the United States and the general introduction of vaults and strong boxes equipped with spindle or combination locks, such as remain the universal safeguard today. It must, however, not be concluded that the weakness of ward or warded locks had not been understood some time before Moore and Hauck made their vigorous demonstration. Linus Yale, Jr, the inventor of the type of lock which still bears his name, had made many demonstrations of lock picking 15 years earlier and similar feats had been performed by British lock experts including the familiar George Price and one of the Chubbs. A lock depending on wards to prevent opening with the improper key was shown to be easily negotiated with nothing more formidable than a bent wire and a thousand common house-burglars on both sides of the Atlantic had used wax to make skeleton keys and open the commoner sorts of warded locks. The answer of lockmakers had, up to the time of Yale and his contemporaries, been a mere complication of the ward lock. It was more difficult to fit with keys, but nothing beyond that. Moore made the final dramatic demonstration.

Perhaps it is well to glance briefly at the historic development of the lock and the key before proceeding. Primitive devices of this kind were in use both in Mesopotamia and Egypt as early as 2000 B C. The mysterious Biblical passage, Isaiah xxii, 22, "And the key to the house of David will I lay upon his shoulder," becomes clear enough when one sees such a key or muftah, the word used then and now in the East. The muftah is a stick of wood from 15 to 30 inches long, two to four inches broad and one to two inches thick. Into the face of one end are set a number of wooden or iron pegs about an inch long. These pegs correspond with as many holes in the wooden bar or bolt which locks the door and can only be lifted when these pegs enter the holes and lift a corresponding series of pins, which drop home by force of gravity and keep the bar locked until pressed up by the key with its pegs. Such huge keys were carried on cords slung over the shoulder. They opened the way into the mighty palaces of Nineveh and Persepolis and admitted to hundred gated Thebes."

Some authorities consider that Chinese puzzle locks are even older but this I question for a variety of reasons too involved for present discussion. What is true about the Chinese lock is that it was the unquestionable parent and prototype of the combination or dial lock. It opened when a secret series of characters was brought into proper juxtaposition by spinning the figured barrel or spool on its core or spindle—the same principle which governs the locks of today's great banks.

The medieval lock was a simple form of the warded type, usually opened with a heavy and marvelously wrought and decorated key. Artisans of those times, lacking the inventive imagination of later centuries, supplied great complexity and artistry instead. If their locks were not efficient they had at least the virtue of looking formidable.

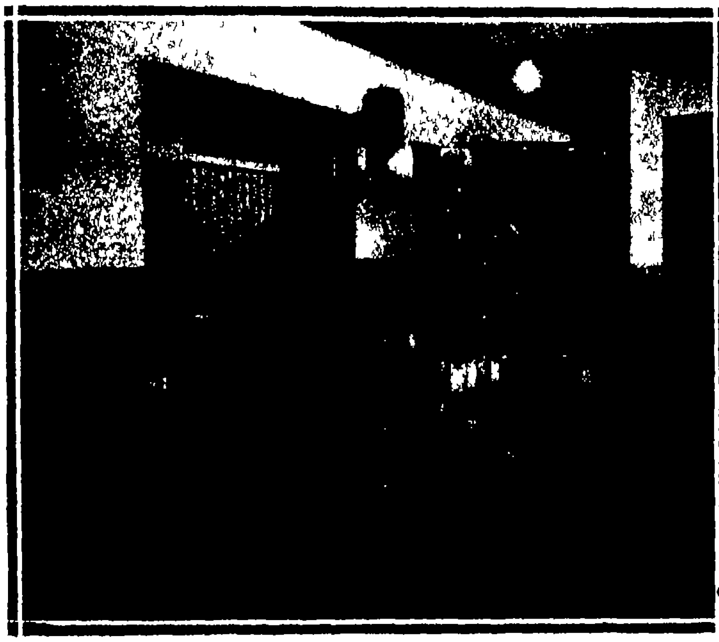
One might, without too much expanding of the material, write a tome or two on the locks that have been invented and patented in modern times, even since 1850 say. The stream of applications to the patent offices of the various countries has been steady and of heavy volume. Even the various kinds of automobile locks evolved since that handy and much stolen vehicle came into the market, in the present generation, would make up a formidable procession.

Speaking broadly and without respect to accurate distinctions, modern door locks have been of only a few general varieties—ward locks, spring lever locks, tumbler locks, as first evolved by Yale, combination locks and time locks. Each type has, of course, been subjected to almost innumerable variations, complications and specializations. The point of human interest that scarcely needs stating is that all these many and ingenious developments, from the beginning of history to yesterday, owe their impelling force to the thief. The wily descendant of the cunning Autolykos has moved the imaginations of how many thousands of inventors? The charm of the situation is that he continues to whip and drive for the unbeatable lock has not yet been designed great though the progress has been. Even the finest and most expensive locking mechanisms of this late and towering age have been defeated or circumvented at times and constant vigilance is necessary. The guardian lock must itself be guarded. Bankers and others having large values in money and goods in charge will be able to confirm this simple truth.

Some of this guarding of the locks has been accomplished by auxiliary mechanisms. In my recent article on the protection of great bank vaults there was set forth some of the workings of the most modern electric burglar alarms which give a signal when any lock in a bank is opened or closed which reveal whether the combinations have been properly mixed and set up a clamor if a wrong key is inserted into the lock of a safe deposit box. But mechanical protection of mechanisms has also been carried along another line of development and resulted in the so-called relocking devices, intended to foil the burglar who may have successfully attacked the lock mechanism of a safe or vault.

Relockers do not figure much in the calculations of urban bankers or those who make the great vaults employed in big financial houses. But to the country bank with its necessarily frailer equipment the relocker has become a most important aid. The rural or suburban bank has suffered for two generations from the attacks of burglars using explosives and latterly from those who employ the cutter burner torch. Both types of bank yeggs have found it easy enough to make their way to the lockboxes of such vaults as are ordinarily employed in minor banking houses. Once arrived at the lockbox it was no feat to pull back the bolts and open the door.

To prevent just this there came into the field a number of mechanical devices, among them the well known dynamite trigger. This was a little arrangement of dogs or detents actuated either by gravity or springs which fell or were forced into place behind the inner ends of the bolts as soon as the locking mechanism was interfered with. Many ordinary office safes are equipped with such devices. Their fault has always been that the burglar who got a hole into the door of a vault or safe could readily push back the dogs or triggers with a stiff bent wire. He was as usual well acquainted with their location and character.



Time lock on the door and combination or spindle locks on the jamb
Another assembly that gives the cracksman a tough job

In the last few years however relockers of a more effective kind have come into the market and at least one of them deserves special mention. This is an arrangement of extra and entirely separate bolts which spring into special sockets in the jamb of the safe or vault the moment an attack is made on the locking system proper. These auxiliary bolts are not only quite separate from the locking device itself and actuated by a special force but they are situated at points on the vault or safe door as remote as possible from the original lockbox—usually the top or bottom of the door or far up and down at the jamb. (See accompanying illustrations.)

Relockers of this kind have been found effective enough in small and exposed banking houses, post offices offices and plants where tempting sums of money must sometimes be kept in safes or old fashioned vaults. They are coming more and more into favor and even provide some degree of protection against the acetylene torch burglars who are gradually supplanting the old nitro yeggs. Gas bombs are now commonly used in connection with them. I have previously noted the weaknesses of and objections to the last named protector.

Mechanical devices such as small fences of stripped steel placed over the dial of the combination lock are also in the very greatest banks for the purpose of guarding these locks from the prying eyes of some employee who might be loitering near when the proper officials opened the lock some disastrous morning. More than once the same numbers have been thus spied out by sharp eyes and used for larcenous purposes.

The time lock, with whose name most readers will be familiar, may itself be included among mechanical devices used to protect the main locks of vaults. A time lock in the simplest terms, is a train of gears which are wound up and let run down in a certain predetermined number of hours or minutes. The first of them were made with only one movement. Today they are commonly made with three and often four clocks. Such mechanisms are used as auxiliaries to the combination or main lock of a fine vault. Until the clocks of the time lock have run down it is impossible to open the vault door even though one have the proper combination. When the vault door is properly closed at night no one can enter—unless he be a superburglar—until the movements of the time lock have run their appointed course of hours. Oppositely even when the time lock has run down the vault cannot be opened except by one who knows the combination. To insure the greatest safety such vault designers as Mr Frederick S Holmes, to whom I am again indebted for material, now usually place the time locks on the back of the vault door and the combination lock on the door jamb. Thus a burglar would have to demolish both the door and the front wall to effect an entrance. When one considers that the wall of a vault into which the door fits—the vestibule wall—is often more than four feet thick and that the spindle of this lock must reach through this wall from the dial to the back of the disks the impressiveness of the device appears. Such a lock spindle is often five feet long.

Having made the general observation that all kinds of locks have been beaten by burglars occasionally at least we come to the old question of the possibility of defeating the dial or combination lock without the use of explosives or destructive agents of any kind. There has always been argument on this point. There have in the past been devised many fictions on the subject. The whole question wears the fabulous habiliments of romance. To recount only the most celebrated instance of fictive meandering we must go back to O Henry and to Paul Armstrong, who dramatized the former's "A Retrieved Reformation" into the play "Alias Jimmy Valentine." Henry, who should have known better, permitted his hero to open the vault of a city bank in a few minutes with a marvelous set of burglar's tools such as never were on land or sea. In making the dramatization Armstrong went him one better. His hero sensitized the tips of his fingers by rubbing them excruciatingly over a sheet of sandpaper and then felt the combination open, releasing the imprisoned and slowly stifling heroine.

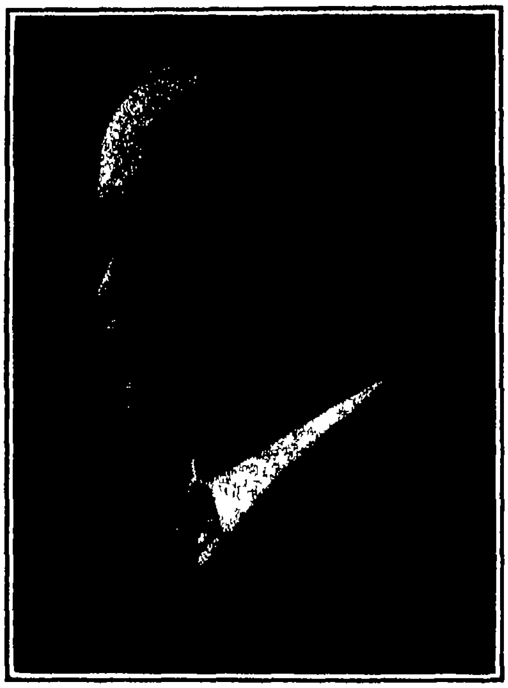
Safemakers laughed. Burglars chortled with amused incredulity—many of them, all I ever talked with on the subject. I myself being summoned for an opinion dismissed the idea with too much scorn it appears. For half a dozen years the question kept bobbing up from time to time and though I inquired far and wide among all who might have been expected to possess special knowledge on the point no one appeared who had the least confidence in the notion.

Then came the sudden and dramatic apparition of Mr James Blancolo, up to that moment an obscure safe repairer and dealer in lower New York. The district attorney had seized the office safes of Brindell, the convicted labor organizer, and wished to get at the contents before the trial for what evidence of crime

(Continued on page 142)

Power from Mercury Vapor

Astonishing Fuel Economy Brought About Through Ingenious Combination of Mercury Vapor and Steam



W. L. R. Emmet, designer of the mercury vapor boiler and engine

THERE is now running as part of the equipment of the Hartford Electric Light Company a combined mercury vapor and steam plant which is showing a truly astonishing fuel economy and in spite of its extreme novelty is operating with all the regularity of a standard steam plant.

It has been recognized for long past that there was promise of great economy in the production of mechanical power, if a way could be found to utilize the vapor of two different fluids each having its own characteristics of vaporization. Many of our readers will remember the experiments made at the well known Charlottenberg Technical School at Berlin with an engine built on the binary fluid system, in which mechanical power was secured by the joint action of steam and the vapor of a highly volatile liquid.

Among the most promising combinations theoretically was in the combined use of mercury vapor and steam but nothing was ever done in this direction, so far as we are aware until Mr. W. L. R. Emmet began about twelve years ago a deep study of this subject during the course of which the General Electric Company built for him at Schenectady an experimental mercury boiler and mercury vapor turbine. This apparatus gave sufficiently promising results to warrant the construction of a second installation and accordingly they built the present mercury and steam plant which is of no less than 6000 horsepower. It has been erected at the Hartford Electric Light station, where it is now being operated as part of plant.

The inventor is well known to our readers as one of that brilliant group of men which the General Electric has gathered at the laboratory of the Schenectady plant. He was responsible for the development of the Curtis Turbine and the promotion and direction of the company's steam turbine activities for many years. He is also the originator of electric ship propulsion, and has promoted and very largely designed the applications of this system which have been made in the United States Navy and elsewhere.

Mr. Emmet estimated that if the mercury boiler came up to all expectations when compared with a steam turbine generating plant which uses 200-pounds steam pressure it would produce with 35-pounds gage pressure about 52 per cent more output in electricity per pound of fuel. These results are now being realized in the plant at Hartford. "And if," Mr. Emmet adds, "in such a plant the steam boiler room were re-equipped with furnaces and mercury apparatus arranged to burn 18 per cent more fuel, the station capacity with the same steam turbines, condensers, auxiliaries, water circulation, etc., would be increased about 80 per cent."

The process is novel in every particular, and it was necessary at the outset of the investigation, to make an elaborate study of the characteristics of mercury and its vapor. During the earlier experiments it was found that no form of packing of the joints would resist the mercury vapor, and were it not for the development of arc and acetylene welding, the construction of the boiler and its connections would have presented a most difficult if not insoluble problem.

It was necessary for the inventor not only to design entirely new apparatus but also to devise methods of operation. Since there was no past experience to draw upon Mr. Emmet had to design from the ground up, an entirely novel plant, which was built at Schenectady shipped to Hartford erected and started and has been successfully operated, exactly as designed, for several consecutive months.

The mercury vapor process involves the vaporization of mercury in a boiler driving a turbine by the mercury vapor, and the condensation of the exhaust in a condenser where its latent heat is delivered to water and thus used to generate steam at a pressure suitable for use in the existing steam plant. The condensed mercury runs back by gravity into the mercury boiler. Thus the mercury vapor acts as a heat conveyor and, at the same time delivers energy to the mercury turbine. This affords a means by which the temperature range of operation is more than doubled as compared with ordinary steam processes, and the efficiency consequently greatly increased. Means are also provided by which the flue gases are brought to temperatures equivalent to those used in steam plants by being carried through a mercury feed heater a steam superheater, and a feed water heater. Mercury boils and condenses much like water, except that its density is much greater and its boiling temperature much higher. At atmospheric pressure mercury boils at 677 degrees Fahrenheit and water at 212 degrees. Mercury condenses in a 28-inch vacuum at 455 degrees Fahrenheit and water at 100 degrees. The great economy of the Hartford unit is due to the high boiling-point of mercury and the relatively large amount of heat that is stored in the vapor.

The tubing of the boiler, in which mercury vapor is produced at 35 pounds to the inch pressure, for operating a single wheel turbine

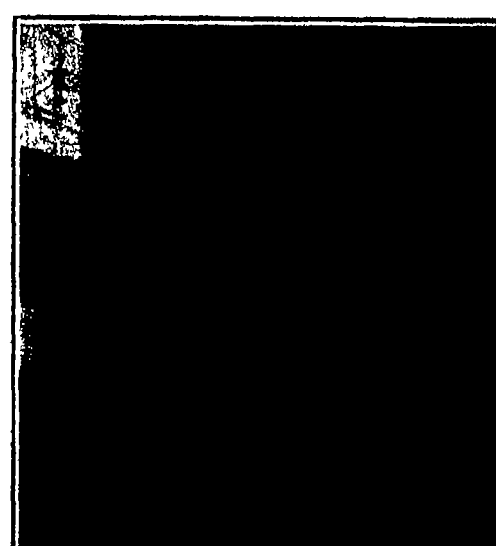
The mercury boiler plant as erected at the Hartford station, is housed in a two-story steel and brick building which is about 25 feet square and 40 to 50 feet in height. On the ground floor are the mercury boiler, mercury heater steam superheater, and feed water heater, on the floor above are the combined mercury-vapor condenser and steam boiler and the mercury vapor turbine, which is direct-connected to a 1800-kilowatt generator. At present the steam generated by the condensation of the mercury is led directly to the main steam line of the plant. Ultimately it will be possible to utilize this steam in a steam turbine, the supply of steam at 200-pounds pressure being sufficient to drive a 2200-kilowatt generator.

The accompanying photographs represent certain parts of this installation and in our wash drawing, which is schematic in character, the various elements have been rearranged so as to render the plan more intelligible to the lay reader. Hence, we show the steam being led directly to a steam turbine, which is direct-connected to a 2200-kilowatt generator.

The mercury boiler, shown at "B," consists of a nest of hexagonal tubes carried at the top of a circular firebrick furnace, "A," which is provided with three oil fuel burners "a." These tubes are arranged in groups of seven, of which the center tube has a single wall and serves for the down flow of the mercury, and the six tubes grouped around it are double walled and serve for the up-flow of the mercury through the annular spaces. The base of the down flow tubes is provided with a slot which permits the mercury to return through the circular honeycomb system thus formed. It will be noted that the arrangement is similar to that of the radiator of an automobile, and its object is to secure a very large evaporating surface. The mercury commences to boil at 677 degrees Fahrenheit, and the vapor is led at 35-pounds pressure to a mercury vapor, single-stage turbine "G," where it condenses in a 28-inch vacuum at a temperature of 455 degrees. The condensation takes places amid a nest of tubes carried at the mid height of the condenser "H." These tubes are filled with water, which boils under the great heat of the mercury vapor and generates steam which collects in the steam drum above at a pressure of 200 pounds to the square inch. The condensed mercury falls to the bottom of the condenser, from which it flows by gravity through the pipe "J" to the bottom of a mercury heater "C." This heater consists of a nest of vertical tubes, and as the hot gases from the mercury furnace pass up around the tubes they preheat the mercury, which returns to the mercury boiler "B," thus completing the cycle.

Although in our diagram the steam from boiler "H" is shown as being led directly to the steam turbine which runs the generator "L," in the Hartford unit it is first led through the nest of tubes of a superheater "D" where the furnace gases give up more of their heat. From the steam superheater, the hot gases are led down through a feed-water heater "E." Finally at "N" they pass to the smoke-stack at about the same temperature as the gases from a standard steam plant.

We have already stated that because of the extreme novelty of this invention, Mr. Emmet was obliged to do his work from the ground up. Very little was known about the action of mercury, under the proposed conditions of high temperature necessitated in the proposed boiler and engine. There was the serious problem of making mercury tight joints in the boiler the piping and the turbine, for mercury fumes are highly poisonous. The use of packed joints was out of the question. Hence, it was determined that the only satisfactory method of sealing the joints was to weld them. A few years ago this would have been impossible, but thanks to the



Special design of wheel for the mercury turbine

development of oxy-acetylene and electric welding it was possible to produce gas-tight welded joints throughout the whole of the plant, and this has been done with highly satisfactory results.

Another problem was that of providing for expansion in the piping and this was done by using annular steel discs welded at their outer and inner edges, thus forming an accordeon like construction which provided for free longitudinal movement. This device is operating successfully.

When the reciprocating engine had been fully developed, the first notable advance in economy was the replacement several years ago of the reciprocating engine by Parsons' epoch making invention the steam turbine.

The modern steam turbine, under similar conditions, is about 40 per cent more efficient than the best reciprocating engine, and the attainment of this degree of gain has been the work of twenty years. "It would seem," Mr. Emmet says, "that the introduction of the mercury process would accomplish an even greater gain." The change from reciprocating engines to steam turbines necessitated complete redesign of the old stations. But, in applying the mercury process, it is only necessary to replace the steam boiler in the large modern plants by a mercury boiler which will give greatly increased output in the same space. In other words, there will be no general redesign of a station to obtain the benefit of the better economy and at the same time materially increase the output from the building. As in all great steps in advance, time will be required to develop and perfect this system before it can be expected to reflect on the operating costs of the public utilities as a whole.

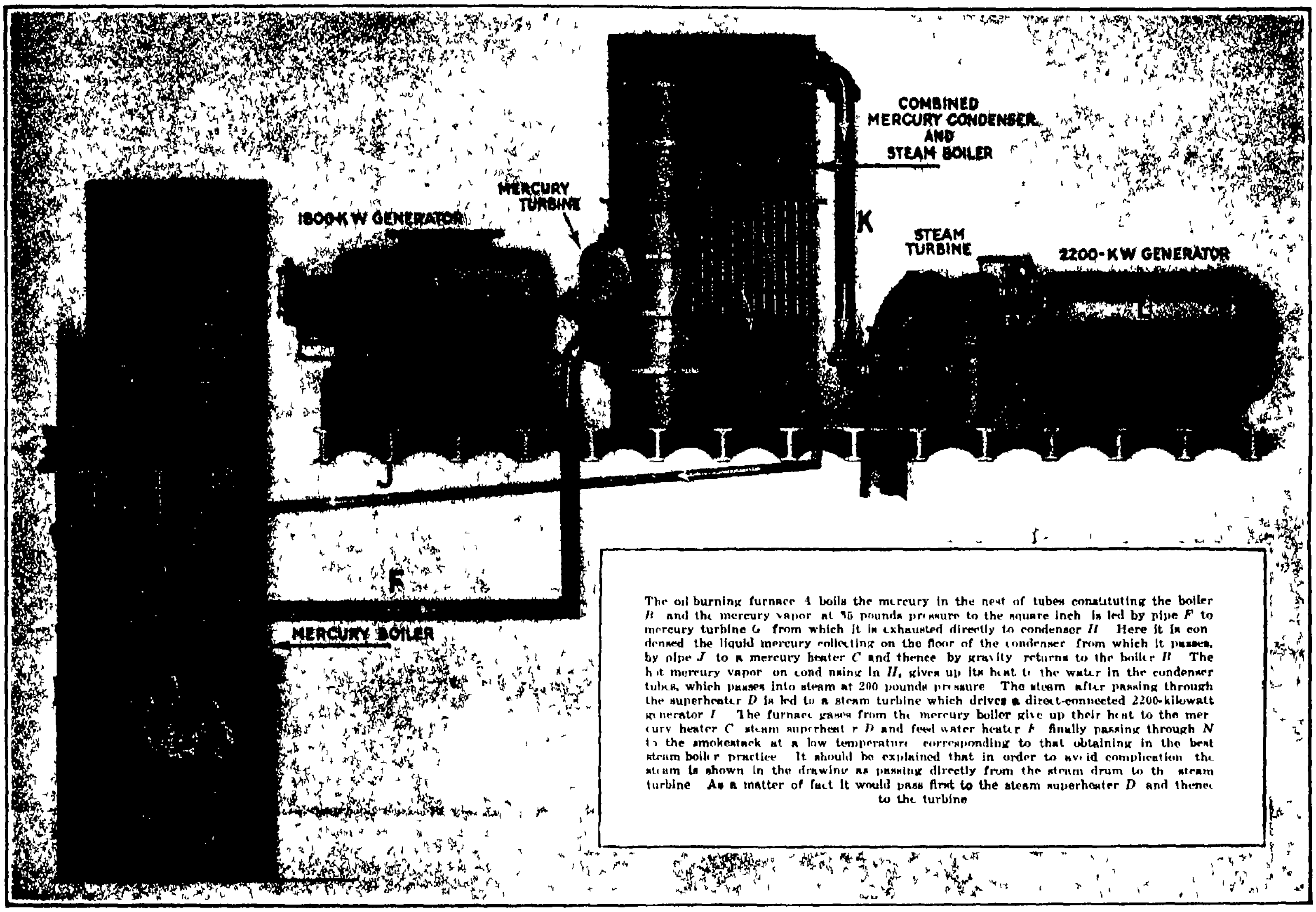
Naturally the question will arise as to whether the new process involves danger from mercurial poisoning, either to the community or to the attendants. In the first place, as previously stated, all joints are welded, so that it is impossible for mercury to escape except through accident, and in the second place arrangements are such that leakage, if it should occur, will be carried into the stack where it can do no harm.

At present mercury sells for about 80 cents a pound. The boiler installed in Hartford contains 30,000 pounds of mercury, and is designed to give from mercury and steam about 4100 kilowatts or say to about 7.3 pounds of mercury per kilowatt. Recent experiments indicate that in future design four pounds per kilowatt will be sufficient.

During our visit to the plant Mr. Ferguson, President of the Hartford Electric Light Company, expressed himself as greatly impressed with the performance of the new unit and went on to say:

"Large as is the item of fuel in the cost of making electricity, it is only one item and the fact that electric power companies can look forward to making their coal go twice as far does not mean that electric light rates can be cut in half. We figure the cost of current in Hartford at three cents a kilowatt and of this fuel represents only eight mills. The rest of it is represented by labor costs and the heavy overhead necessary for an electric power company to be in readiness 24 hours a day to furnish power and light, whether it is called for or not.

But as the mercury boiler comes into general use and is perfected, we have every reason to hope that it will bring a saving in the power bill to the consumer for reasons of our own prosperity as well as that of the consumer. With coal and transportation as expensive as they now are, the manufacturers of the Eastern seaboard states are at a distinct disadvantage compared to those further west where coal is nearer, tending to draw manufacturers away from this field. A lowering of the rates here would aid both the public utilities companies and the population generally."



The oil burning furnace A boils the mercury in the nest of tubes constituting the boiler B and the mercury vapor at 35 pounds pressure to the square inch is led by pipe F to mercury turbine G from which it is exhausted directly to condenser H. Here it is condensed the liquid mercury collecting on the floor of the condenser from which it passes by pipe J to a mercury heater C and thence by gravity returns to the boiler B. The hot mercury vapor on condensing in H, gives up its heat to the water in the condenser tubes, which passes into steam at 200 pounds pressure. The steam after passing through the superheater D is led to a steam turbine which drives a direct-connected 2200-kilowatt generator I. The furnace gases from the mercury boiler give up their heat to the mercury heater C, steam superheater D and feed water heater E, finally passing through N to the smokestack at a low temperature corresponding to that obtaining in the best steam boiler practice. It should be explained that in order to avoid complication the steam is shown in the drawing as passing directly from the steam drum to the steam turbine. As a matter of fact it would pass first to the steam superheater D and thence to the turbine.

Schematic view arranged to show the various elements of the mercury vapor and steam unit of 6000 horsepower, now operating as part of the plant of the Hartford Electric Light Company

Extinguishing Ignited Gas Mains

IN large cities where electric cables, gas mains and sewers are huddled together underground the gas mains sometimes become ignited due to leakage, short circuits in the electric cables and similar causes. This condition usually takes place in one or more adjacent manholes.

Recently a large gas main serving thousands of gas users was ruptured and at the same time a short circuit occurred in a high voltage cable. The explosion broke open the main the ignited gas roaring up some 45 feet into the air. The heat was so intense that neither firemen nor gas repair men were able to reach within many feet of the flame. The broken pipe was fed with gas from both ends. It was considered inadvisable to shut off the gas at the gas house because the lives of many hundreds of gas users would be endangered should their gas burners be turned on when service was renewed after repairs.

After the fire had roared for considerable time a very interesting method of snuffing it out was adopted. Holes were dug in the street one on each side of the fire and as close to it as was feasible. When the large gas main was exposed at both places, men were put to work to drill a hole about 1¼ inch in diameter in the pipe at each place. Both holes were completed at about the same time, as each gang was synchronized with the other.

As soon as both holes were completed, a leather bag very much like a child's toy balloon only folded up to look more like a cartridge, was inserted into each hold in the gas main. Once inserted in the gas main an air pump was connected to each bag and the bags pumped up to a pressure of more than 80 pounds. As the bags or balloons filled with air they became bigger and conformed to the shape of the main. The bigger they became the more they restricted the flow of gas until finally the gas was shut off entirely and the fire was snuffed out.

This method of "snuffing out" an ignited gas main is safe. It does not endanger people connected to an extensive network of pipes and minimizes the interruption of service by affecting only the section of gas main involved.

Our First Rigid Airship the "Shenandoah"

The Design, Construction and Successful Trials of the Great Airship Built by the United States Navy

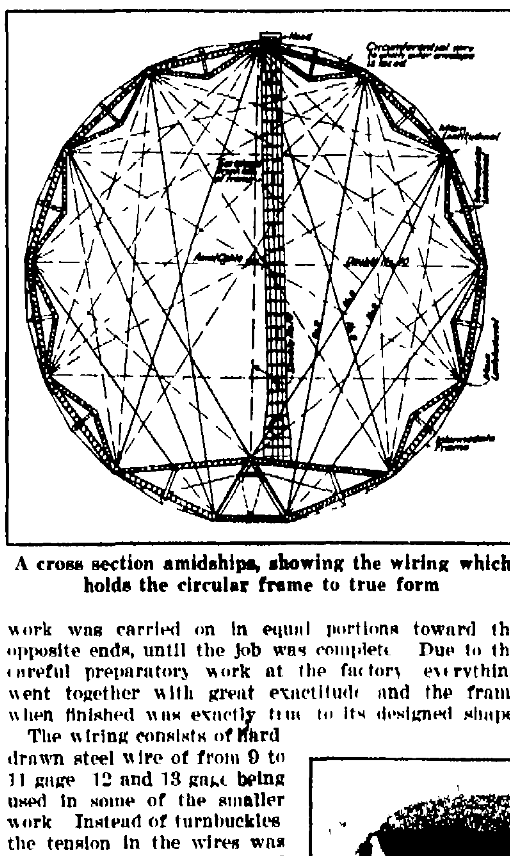
Placing the outer covering on the bow of "Shenandoah." Note the netting against which the gas bags bear

IT WILL be admitted that credit is due the United States Navy for its courage in carrying, through the construction of a Zeppelin type of airship, at a time when faith in these fragile constructions had been rudely shaken by the tragic loss, with British and American officers aboard of a similar type of ship, built in England for the United States Navy. The type was further discredited when the British Government discarded its airship fleet altogether, and offered it to any private interests that would take over its ships and operate them commercially. Our Navy Department, realizing that nothing had happened to prove that the theory of the airship was at fault was not discouraged by this accident and the subsequent action of the British Government. The Department believed that profiting by the experience and accumulated technical data of the past and by careful work in the designing office and in the testing room it would be possible to build an airship of the largest size that would stand up to its work endure any of the stresses to which it would be exposed in service and would provide the Navy with a most important addition to its scouting forces. That the Department was not over-optimistic has been proved by the consistent performance of our first rigid airship and the facility with which it has been handled in a series of long distance trips that were made during the latter part of 1923.

The Shenandoah was designed by Commander J. C. Hunsaker of the Construction Corps of the United States Navy. The design of the details the building of the various parts of the structure and the installation of the power plant were done under the direction of Commander G. C. Westervelt of the Construction Corps of the Navy at the Naval Aircraft Factory Navy Yard Philadelphia. The erection of the ship took place in the large hangar at Lakehurst New Jersey under Commander R. D. Weyerbacher also of the Construction Corps of the Navy.

The ship is of the usual cigar-shape form with a circular cross-section. She is 680 feet long, and 79 feet in diameter at her mid-section. The frame is built up of circular rings spaced 32 feet 9 inches apart and rigidly tied together by 13 longitudinals and the whole frame as thus built up is maintained in its true form by an elaborate system of wire diagonal bracing in the plane of each ring and in the planes of the rectangular panels formed by the intersection of the circular frame members and the longitudinal members. The above constitutes the main structural frame upon which the rigidity of the ship as a unit depends. But half way between the main frames are other frames of lighter section which are not provided with wire bracing also intermediate with the main longitudinals are others of a lighter section. The panels formed by these intermediates and the main longitudinals are also braced by secondary wire diagonals at the outer surface. There are 13 of these main longitudinals and 12 of the intermediate or secondary longitudinals, and hence the surface of the finished ship when covered with fabric, presents the form of a polygon of 25 sides. The entire frame, as thus assembled, consists of duralumin struts and girders and wire tension members. Its weight, in spite of the vast size of the structure is only 15 tons and there are no less than 3000 struts, big and little, employed.

Duralumin was developed for airplane and airship construction. It is a remarkable metal for although its specific gravity is only a little over one-third that of steel it has an elastic limit of around 35,000 pounds and an ultimate breaking strength of 55,000 pounds. The girders and struts are all triangular sections, and they are built up of rolled longitudinal members, latticed together with special form, sheet-duralumin lattice pieces. As we have said, the fabrication of the parts was done at the League Island shops where everything was built and the holes were drilled, preparatory to rivetting the frame at the Lakehurst hangar. The assembly and rivetting up of the smaller parts was done at the Naval Aircraft Factory and the final assembly of the frame itself was done at Lakehurst. The great ring frames were assembled in a floor jig in a horizontal position and rivetted the wiring which holds the ring to shape being inserted and given the necessary tension to bring the ring to true form and hold it rigidly. The assembly of the frame was started at the center of the length of the ship the longitudinals were rivetted in place and the diagonal wires inserted and drawn up until everything was in proper alinement and the wires given their proper tension. The work was carried on in equal portions toward the opposite ends, until the job was complete. Due to the careful preparatory work at the factory everything went together with great exactitude and the frame when finished was exactly true to its designed shape.



A cross section amidships, showing the wiring which holds the circular frame to true form

The wiring consists of hard drawn steel wire of from 9 to 11 gage. 12 and 13 gage being used in some of the smaller work. Instead of turnbuckles the tension in the wires was secured by the use of end loops and a special tensioning device. The maximum tension used was 300 pounds.

From our description, it will be seen that the main frames divide the ship longitudinally into sections which are 32 feet 9 inches wide by the full diameter, 79 feet, of the ship.

Each of these spaces is occupied by its own gas bag which is made of goldbeater's skin a light strong material which is impervious to gas. At the top of the bag is an escape valve operated by hand through a light cable leading to the control car, and at the bottom is an automatic release valve, which vents upwardly to the top of the ship through a tube which passes between the bags. The inner surface of each frame is covered with a network of No. 13 wire which is fastened to the channels of the longitudinal members and to the ring frames. The spaces in the wire mesh measure about 18 inches, and inside this mesh is another netting of cord with a nine-inch mesh. The outward pressure of the gas in the bag is transmitted through this netting to the frame of the ship. The outside of the "Shenandoah" is covered with a skin of rubberized fabric which is laid on in wide longitudinal strips that are laced around the edges of the frame members. The longitudinal seams of this covering are closed with other strips which are cemented on. After the covering was completed the whole surface was coated with cellulose acetate.

As will be seen from our cross sectional view of the ship taken amidships, the lowest member of the outside of the ring is shorter than the others, and from its ends there rise two inclined members which meet and form a closed triangle. From the apex of this frame, two girders extend to the sides of the ship and are connected to the nearest panel points of the main frame. These triangular frames are erected upon the ring frames and are connected together by longitudinal girders, the whole forming a stiff triangular construction extending throughout the length of the ship. A short distance below the apex of the system, the side legs are connected by small transverse girders and upon the platform thus provided, at certain selected locations, are carried the fuel tanks, which are hung in groups along the length of this keel. Water ballast tanks containing one ton of water each are placed in the same structure. The pull of the propellers is applied to the frame at the frame panel points to which the power cars are attached. The pull is also transmitted by wiring carried from the motor cars to the frame.

The fuel is contained in 40 tanks, each holding 113 gallons, making a total load of 4520 gallons. If it were desired to fuel up for a lengthy non-stop trip, it would be possible to install 78 tanks holding a total of 8834 gallons.

It will be realized from the above description that the concentrated static loads of the fuel, and of the engines and the propulsive force of the latter, are concentrated at certain definite locations along the 680-foot length of the ship. The heavy stresses resulting from the action of the fins and the vertical and horizontal rudder, act immediately on the after or tail section of the frame.

Now it will be understood that the determination of these localized stresses, and the way in which they distribute themselves throughout the whole frame of the ship called for some very careful designing and with a view to checking up the calculations of the naval constructors, an engineering board, composed of men outside of the Navy was appointed by the Navy Department to make an independent investigation of the design. It is gratifying to know that this board has endorsed the design as being fully adequate and reli

"Shenandoah" moored to her steel mooring mast, 167 feet in height. She is maintained on a level keel by discharging gas if she rises, and water if she falls

able. Tests were made in the hangar with the gas bags completely filled, by applying loads at selected positions along the keel and recording the effects on the frame Then the loads were moored to other positions and the stresses noted. Also local tests were made on various parts of the structure The reading of the stresses was done by the McCollum Peters carbon resistance strain gages of the Bureau of Standards These 'shop tests" have been supplemented by strain gage tests taken during the various flights of the "Shenandoah" during the past autumn Although the maximum working stress, as calculated was 9000 pounds per square inch, the strain gage reading shows that the maximum stress when the ship was in flight was 8000 pounds per square inch

In designing the "Shenandoah many minor factors were sacrificed to safety and reliability In other words, the "Shenandoah,' relatively to previous airships, is of unusually strong construction From the data secured in active service our naval constructors will be in a position to develop a ship which will be faster will possess a larger radius of action, will be lighter will carry a bigger load, and at the same time will be safe and reliable The weight of the 'Shenandoah at present is 33 tons of which the useful lift is between 12 and 13 tons Her maximum speed is about 65 miles per hour

In a recent article describing the flight of the "Shenandoah over New York City, the writer dwelt upon the beauty of the ship and the perfect control which was evident in her various maneuvers To give an adequate impression of the majesty of such a great airship as this one must view it at close range, and this can best be done by a visit to the great hangar in which she is housed at Lakehurst, New Jersey The hangar which was built some three years ago, towers in the center of a level plain which has been cleared for the purpose in the forests of New Jersey Here everything is on the grand scale The hangar measures 952 feet over all and 348 feet wide, and has a total height to the top of the roof of 201 feet The inside dimensions are 803½ feet by 258 feet with a clear height of 172 feet and within this vast space there is an abundance of room to house side by side two dirigibles of far greater size than the "Shenandoah" and still have all the room needed to handle them Running the full length of the hangar is a series of steel tracks, which extend far out into the field ahead These are provided with electric trolleys to which the ship can be attached by cables and thereby be securely drawn into the hangar The building is closed by two vast sliding doors each of which weighs 1300 tons They withdraw transversely upon steel tracks and are operated by electric motors.

By the courtesy of Captain McCrary, who is in command at Lakehurst, the writer made a thorough inspection of the pilot car, from which the ship is navigated and of the interior of the ship itself Our colored cover and one of the accompanying photographs show the interior of this car looking forward. In common with all the motor cars, it is built of aluminum and around the front and sides are large windows affording a wide range of vision The car is about 20 feet long with a clear inside height of about 8½ feet The lettered photograph with its caption will make clear the position of the various instruments and their use. The navigation of the "Shenandoah is in many respects similar to that of sea navigation She is steered in a horizontal plane by the wheel at the front, and in a vertical plane by the wheel shown to the left. The pilot in front has a compass before him and in front of the wheel controlling the elevation are two inclinometers To the right is a chart table with a five-inch compass recessed below the board There are instruments for showing the speed of the ship a telegraph dial for engine control, a barograph, altimeters, and a gas pressure indicator To the left near the ceiling are the terminals of wire ropes leading to the valves for venting the gas when it is necessary

"Shenandoah' is driven by six 6-cylinder engines contained in six separate cars, of which the pilot car is the largest The engines are identical and each can develop 300 horsepower at 3000 feet The pilot car is hung below the center of the ship forward Abaft of this are two wing cars, each with its own engine and

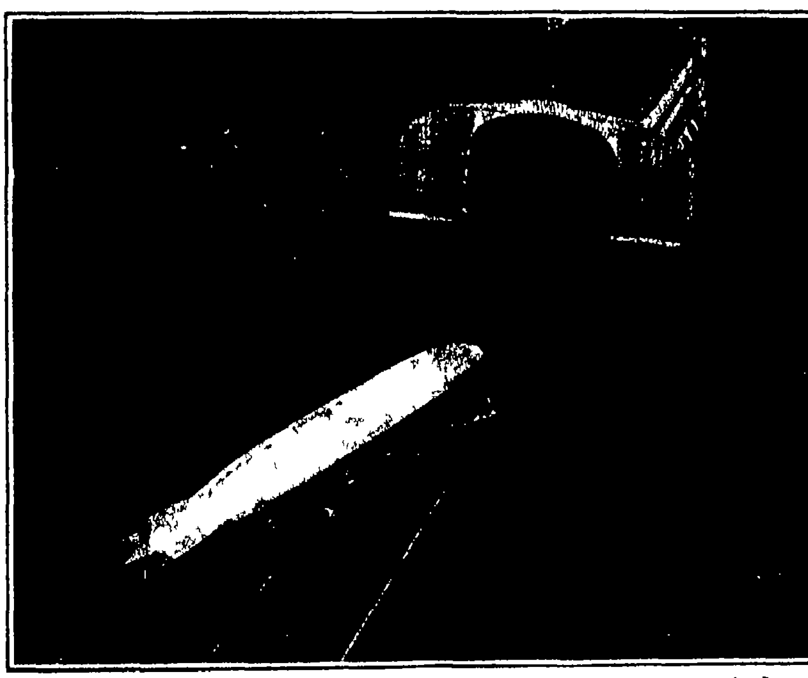
A Altimeter 12 000 ft B Altimeter 30 000 ft C Gas pressure alarm D Pitch indicator E Gas temperature thermometer F Inclinometers 4[?] 15 10 with elevator control wheel below G Variometer H Bracket for barograph J Air speed Reel K Compass 7¼ inches L Air speed indicator M Turn indicator N Variometer P Engine control telegraph dial R: Compass 6 inches below chart table S Chart table T Steering wheel controlling rudder V: Air-speed indicator

The control car from which 'Shenandoah" is navigated

abaft of these and about 55 feet out from the center line of the ship are two other wing cars while astern on the center line is the sixth car The cars of the forward pair are placed about 40 feet apart and those of the second pair about 70 feet apart This staggered arrangement serves to distribute the stresses and avoid interference by the wash from the propellers

Climbing up a vertical ladder from the pilot car one reaches the inside of the ship landing upon a light 10-inch plank footway which runs the whole length above the keel Step off this platform or slip from it and if one were not so fortunate as to land upon some member of the widely spaced frame he would keep going until he reached mother earth for there is nothing to stop him but the thin rubberized fabric of the outer covering Hence the writer felt considerable respect for the crew who are sufficiently expert to climb into and out of and sleep for their "four hours off in a hammock swung between two uprights, with nothing between them and the ground but a thin piece of silk and several thousand feet of the atmosphere Walking down the gangway one sees the framework of the keel below and the vast arms of the circular frames curving around to meet 70 feet above his head Only the lower third of this framework is visible the overhead view being obstructed by the bottom of the gas bags with which the interior is filled

About the middle of the ship one finds the crew's quarters so called, for at the time of the writer's visit they were purely of a temporary nature Outside of the hammock and a bench or two of light construction there was little in the way of accommodation to be seen It is intended however to devise and fit bunks of very light construction and make other provisions for comfort during extended cruises The control of the altitude of the ship is secured by adjusting the quantity of gas in the bags to the total weight As the fuel is consumed and the weight decreased gas must be vented or the ship will rise Similarly when a descent is to be made to the ground gas must be vented again The control of the gas bag is associated with the control of the elevators and by this joint means it is possible to hold the ship at any desired elevation The Shenandoah carries a crew of 22 There are nine officers including the Commanding Officer Captain McCrary the Executive Officer the Navigation Officer three Watch Officers, the Chief Engineer and his assistant, and a Radio Officer



The ground crew guiding the ship into the hangar after her return from St Louis

The Auxiliary Language

WE hear much about the desirability of selecting an auxiliary or synthetic language for international use in science technology commerce radio-communication etc Such a language will never be selected or determined even by authority if we use those words in an arbitrary sense It will rather be discovered that is it will be dug out of the linguistic mines of the Occidental world This procedure was seemingly followed by a group of linguists and specialists who met in Paris in 1907 They put the root words of numerous ideas upon the wall as it were in parallel columns in English French Spanish Italian German Dutch etc, and then struck the greatest common divisor so to speak Thus they arrived at maximum internationality and consequent naturalness but governed always by strict regularity and facility Their fundamental principle was enunciated by Professor Otto Jespersen a well known philologist of Copenhagen who said 'That international language is best which is easiest for the greatest number of men' (La internaciona linguo esas la maxim bona qua esas maxim facila por la maxim granda nombro di homi) The development of the language which is known as Ido (pronounced ee doh) has been carried on in like manner by other committees some of which are still engaged in the task Every root word or element chosen is voted upon by the members of the committee in various parts of the world Such active collaboration is just what is needed to insure the requisite neutrality accuracy and expressiveness The resultant language which is very flexible is phonetic and euphonious It sounds something like Spanish or Italian Being free from any exceptions or irregularities it is obviously easy to learn It is indeed understandable almost at first sight particularly by any one having the least knowledge of any Romance language Translations from difficult works by Henri Bergson and Einstein have it is said been successfully carried out thus showing the ability of the language to respond to intricate thought In spite of its simplicity the language is said to be so perfectly logical that it is free from all ambiguity Next we may hear of American radio amateurs communicating in a common tongue by wireless across the Atlantic with radio fans in France Belgium, Holland Denmark, Switzerland etc

Our Point of View

The Two Fluid Engine

IT is acknowledged that the great turbo-electric power stations of the country have carried the development of the steam engine to a higher level of economy than has been anywhere attained, at least on a large commercial scale. The modern steam turbine as employed in the big power stations is said by Dr. Emmet of the General Electric Company to be 40 per cent more efficient than the best reciprocating engines. This is accepted as the high water mark of present steam-engine practice.

In view of the excellence of this performance it must be admitted that the results which have been attained at the Hartford Electric Light Company with a combined mercury vapor and steam unit which they have recently incorporated as part of their turbo-electric plant are very startling. It is officially announced that as the result of several months operation the coal bill so far as this unit is concerned has been reduced by 52 per cent. This economy is attributed to the high temperature at which mercury boils and the correspondingly large amount of heat which is available first for the operation of a mercury vapor turbine and then for the operation, by the exhaust from this turbine, of a complete steam turbine unit. Not only does the mercury vapor serve to operate an 1800-kilowatt generator but there is sufficient heat left in the exhaust for the operation of a steam driven 2200 kilowatt generator.

How far the new system can be applied to the existing power stations of the world can only be conjectured. If the unit at Hartford continues to show the remarkable economy which has so far been recorded it is only a question of time when there will be a demand for its wider use. This raises the question of the supply of mercury and in this connection Dr. Emmet reminds us that since by the adoption of electric welding he has succeeded in making his boiler and turbine perfectly vapor tight there can be no loss of mercury and a plant once supplied with its quota will require practically no replenishment.

It would seem furthermore, that, by the substitution of electric welding for packed joints the danger of mercurial poisoning has also been eliminated. It is safe to say that the users of power the world over will watch the further development of this apparently epoch making invention with the very closest attention.

In conclusion it must be remembered that in spite of the positive results thus far obtained both the General Electric Company and its inventor consider that the Hartford unit is still somewhat in the experimental stage. They predict that with the use of higher pressures and a mercury turbine of improved design it will be possible to obtain even better results with a smaller charge of mercury.

Oil Fuel as a Life Saver

THE primary advantages of oil firing on ships—its cleanliness, saving of bunker space and the great reduction in the fireroom force are well understood but besides these there are many other advantages of a minor character which in the aggregate are of no little importance. This fact was brought out in a lecture recently delivered in London before the Institution of Mechanical Engineers by Sir Westcott Abell when in speaking of the question of hull sub-division he pointed out that in an oil-burning ship or a motor ship the inner walls of the oil bunkers extending parallel with the side of the ship and say about fifteen feet from the side, actually form an inner skin below the waterline. Not only so but the space thus formed which extends for a considerable length of the vessel amidships, is sub-divided by transverse bulkheads spaced about twenty feet apart longitudinally. Obviously since all this work must necessarily be made watertight the safety of the ship is materially increased.

Another advantage is related to the provision of openings from boiler room to boiler room, which have to be made in the transverse bulkheads of the ship to allow of communication. In the oil driven ship these openings can be made comparatively high up in the bulkheads, whereas in coal-fired ships they must be down level with the boiler room floor. In some coal burning ships, it is true, in which special attention has been given to safety, the bulkhead openings have been placed above the waterline, but such cases have been rare. Watertight doors, moreover, whether they are operated by hand or by power, are more likely to work effectively in the clean boiler rooms of an oil-driven ship than in a coal fired vessel where there is necessarily a considerable amount of dirt and dust. Finally, in case of fire, oil fuel, being distinguished from coal by the fact that there are no interstices in the oil, has the advantage that fire-extinguishing apparatus can work to much greater advantage.

Mr. Hoover on the American Merchant Marine

IN the opinion of the Secretary of Commerce, it is simply a truism to say that we must have an American overseas marine. Apart from the impulse of fine sentiment and national pride which renders a great trading nation desirous of maintaining its flag upon the seven seas we need ships of our own for the protection of our foreign trade for the expansion of our export on sound lines and as an auxiliary to our national defense. Many of us have not forgotten that when President Roosevelt sent our fleet around the world it had to depend upon foreign bottoms to carry the necessary coal for refueling.

Our international trade is one of the very foundations of the American standards of living, for our daily comfort depends upon the importation of those things which we cannot ourselves produce. Among these are such commodities as rubber, coffee, sugar, tin, to say nothing of a score of others. Mr. Hoover points out that, in the main the amount of these commodities which we can import will depend upon the amount we can export.

If we are to have secure export markets we must have a certain amount of American-controlled shipping in order to protect us against combinations in rates which would prejudice our goods in competitive markets. We are told that, since the war the facility of the world at large in creating combinations in restraint of trade has been growing by leaps and bounds, and although we endeavor to curb these activities within our own borders naturally we cannot do so abroad. There are in fact, many commodities upon which we are dependent by import from foreign lands, where combinations exist for control of the price of those commodities. These unfavorable conditions do not cease at the seaport—they are very common in the shipping world. Our wheat, for instance, is sold in the world market in competition with that of other countries, and a farmer's return on wheat is fundamentally the price which he receives at Liverpool, less the cost of transportation and handling. Therefore, it is as important to him to be guaranteed reasonable rates of sea transportation as it is on freight carried by land.

Now, the real security amid these conditions lies in our possessing an adequate American-owned merchant marine. The expansion of our foreign trade will depend largely upon the assurance of dependable transportation. If our manufacturers are to be assured of prompt delivery our ships must sail regularly week by week, and our merchants and manufacturers must know that, when they have established a market for their goods in foreign lands, absolutely regular transportation will be assured to them for a period of years to come. In other words, they must not be left depending upon the hazards of foreign ships, working in combination with foreign merchants and competitors.

So looking at the matter in a broad sense, the American people desire to establish a Merchant Marine that will adequately protect their commerce. What they wish for is a regular ferry like service of boats of the mixed-cargo liner type, with moderate passenger accommodations, running on the great trade routes of the world and carrying at least 50 per cent of our foreign trade. Today, outside of oil, we are carrying less than 20 per cent.

The Unity of Mathematics

IN TEACHING more than in any other profession there is temptation to fall into a rut bound conservatism. The inherently self perpetuating character of this profession is responsible for the conservatism in question. Doctors, to be sure, get their training from their predecessors, but when they get out into their profession, they find the technique of practice so different from that of the class-room that there is every opportunity for them to keep their faces forward. But the teacher of this generation is the student of last generation, and when, as teacher, he deals with his students, he finds himself in exactly the same situation that his former teacher occupied in dealing with him. He may meet this in a manner highly inspirational, but only occasionally may we expect to find him developing sufficient initiative to question the fundamentals and to wonder whether the manner in which his subject was taught to him is, after all, the one-and-only God given way to teach it.

In the face of this general observation it is gratifying to survey the collegiate field and to realize that in most departments of instruction the past two decades have seen more or less complete overturns of old practice. Classical languages as well as modern English and history as well as physics and chemistry—all these are being taught in a fashion quite foreign to, and unquestionably better than, that of an earlier generation. And at the moment, the teaching of collegiate mathematics, in which the iron rule of tradition dates further back than in any other branch of instruction is undergoing a similar transformation.

Since mathematical knowledge became sufficient to support such a partitioning, mathematics has been carefully fenced off into algebra, trigonometry analytic geometry and calculus. Under the plan of study thus imposed, the student can form no conception of the character and possibilities of modern mathematics, nor the relations of the several branches as parts of a unified whole, until he has taken several successive courses covering, at best, two and a half years. Unless he be a student of exceptional insight he will in fact master the technique of these separate courses, without ever realizing that fundamentally they all deal with the same thing. He cannot get, early enough, the elementary working knowledge of mathematical analysis, including the differential and integral calculus, which he needs so badly in his other work. He must study many subjects apart from their application in other fields, thus missing their full significance and gaining little facility in drawing upon one subject for help in another.

Suppose that a carpenter's apprentice were obliged to drive nails by shooting them from a shot-gun, and were obliged to master this technique as a prerequisite to being introduced to the more effective tool, the hammer? Absurd, of course, but not one whit more absurd than what is done in collegiate algebra and analytic geometry classes today. The tools of the calculus, simpler and more easily mastered than the roundabout methods of algebra and analytics, are deliberately withheld. The student is obliged to master a complex technique which he is later to discard completely, for two years he is obliged to attain his results in the roundabout fashion prescribed by that technique. This is exactly as sensible as telling the prospective carpenter that hammer and nails are fundamentally different tools, and that he must meet and master them separately. Algebra, analytics and calculus are not inherently separate subjects, they are all one, and should be so taught.

Of recent years there has been a notable trend toward the reintegration of the mathematical field of instruction, and the presentation of the subject in a single continuous course, which naturally revolves en-

Our Point of View

tirely around the concept of the function—the one thing common to all mathematical analysis. One takes up the study of a certain type of function and pursues it to its end without interruption. The work is classified according to the material, rather than according to the tool. It is interesting to know that one can whittle with a screw-driver, if one have no other tool, but if one have the proper tool, the possibilities of the improper one are not worth much examination. In the mathematical as in the mechanical case, there is no valid objection to the early use of the proper tool.

But however we present the subject we must have texts, and the texts which have been available in unified mathematics have been a pretty sad lot. They have been sad in their choice of material, sad in its order of presentation, and especially sad in the degree to which they have made it appear that they were different simply as a matter of faddism, for the sake of being different. We have in fact been so disgusted with them that we have often seriously considered the notion of writing, ourselves, a text in unified mathematics as, according to our lights, it ought to be written.

Prof. Frank L. Griffen, of Reed College, Portland, Ore., has made it unnecessary for us to harbor this idea any longer. What we had in mind, he has done. His "Introduction to Mathematical Analysis," published last fall, hits the mark squarely. From his introductory chapters presenting the basic ideas of the function, the rate and the limit, right through to the end, he gives a thoroughly sound and logical text in the mathematics of the function—free from frills, free from fads and fancies, and in just the right order. If we had our way, every teacher of mathematics would be obliged to read this book, and every person with responsibility for the laying out of mathematical instruction in any of our colleges would be obliged to read a chapter from it every morning before breakfast.

The Hydrographic Office and the Politicians

THE politicians in Washington are trying to get that admirable institution, the Hydrographic Office, away from the Navy and into their own control. If they succeed, the result will be a greatly lowered efficiency for a greatly increased expense and—an added number of comfortable berths to be dispensed among the faithful.

This is the third time, in the past fifteen years, that an assault of this character has been made and for the third time the SCIENTIFIC AMERICAN, after a very careful and thoughtful investigation of the question, goes on record as most strongly opposed to the proposed change. A movement which is excellent in itself, such for instance as the present consolidation of bureaus and departments in Washington, may be pushed too far, and we believe this proposed transfer of the Hydrographic Office is a very clear case in point.

The Hydrographic Office is a branch of our naval activities which, for nearly a century past, has been producing charts, pamphlets and nautical literature for the guidance of navigators, both in the Navy and in the Merchant Marine. That its work is indispensable to the Navy goes without saying, and if the office, or rather the duties of the office, were transferred to the Coast and Geodetic Survey, as is proposed, the work would have to be carried on by the Navy just as it is now, if only to furnish its ships with absolutely reliable information as to currents, tides, winds, soundings, reefs, etc. Hence, the transfer would be a direct duplication of work.

Not only has the Navy, for a century past, been providing its own ships with this information, but it has been cooperating very closely with the American Merchant Marine, the captains of whose ships regularly furnish the Hydrographic Office with reports of the location of wrecks, derelicts, ice, and any other information affecting charts or sailing directions. That this cooperation has been complete and effective is shown by the fact that the Merchants Association of New York during the last assault of the politicians passed a series of resolutions requesting that its Board of Directors strongly oppose any legislation designed to have the Hydrographic Office transferred to the Department of Commerce. And they also made what to our thinking is a most sensible and obvious recommendation that if economy is being sought, instead of the Hydrographic Office being taken over by the Coast and Geodetic Survey, the work of the Coast and Geodetic Survey should be incorporated among the duties of the Hydrographic Office.

For a long term of years preceding the Spanish War, the work of coast survey was done by naval officers, but during the war they were called away. The work was taken up by landsmen and the politicians took care that it was never returned to the Navy. Upon the transfer appropriations for Coast Survey were trebled and today they stand at Hydrographic $405,000, Coast and Geodetic, $2,405,975.

As to the Hydrographic Office at present the work is in the hands of men whose duties take them to every part of the world, to far distant harbors, to remote ports and at times to routes of sea travel which are removed from the main highways of the ocean. Their naval duties call them there and the work they do for the Hydrographic service costs not a cent of the nation's money. There is no body of men that could hope to do it so well or at such little expense.

But let us take a look at the other great maritime nations of the world. How do they manage their affairs in respect to hydrographic work? They do it exactly as it has been done and is being done by the United States Navy. *In every case the Hydrographic* service is carried on by the naval officers of the respective naval services. They all maintain hydrographic offices as vital parts of their Navy Departments, and in all naval countries except our own and Portugal the charts both of their own coasts and of foreign waters are made by the officers of the respective navies. In our own country our coastal charts are made by the non-seagoing forces of our Coast and Geodetic Survey, and although our Hydrographic Office makes and publishes some 7200 charts of foreign waters *it is barred by law from making surveys in its own waters*. Can you surpass this for absurdity?

The Hydrographic Office is in competent hands and with a moderate staff of 464 officers and men stationed at 16 different ports and on the high seas it does its work with remarkable efficiency. The Coast and Geodetic Survey employs over twice that number of civilians. If the Coast Survey were restored to the Navy the Navy will tell you that it could do both the hydrographic and coast survey work with a minimum of men and do it for a mere fraction of the present cost.

A Problem in Helium Filled Airships

THE man who first designs a condenser for recovering the water from the exhaust of airship engines, that is so light as to involve but a small addition to the load carried by the ship, will make a valuable contribution to the success of helium gas as the medium of sustentation.

As everyone knows, the operation of an airship involves a *continual loss of the gas* whether it be hydrogen or helium. This is due to the fact that the consumption of fuel by the engines causes a diminution in the total weight of the ship with the result that it tends to rise above the level at which the pilot wishes to navigate. To counteract this a corresponding amount of gas must be allowed to escape.

Now the obvious method of restoring the balance without the present *discharge of gas* would be either to take weight aboard during flight, which is impossible, or to find some means within the ship itself by which the change in its weight can be prevented. It has been recognized that if the water in the exhaust from the engines could be recovered a long step would be taken in the solution of the problem, and much inventive ability has been directed to the invention of a means by which these gases can be condensed and the weight of the water thus recovered retained as part of the ballast of the ship.

The problem of course is not so serious in a hydrogen filled ship, because of the comparative cheapness of that gas, but when we come to consider helium, which costs at present about $30 per thousand feet, it can be seen that the continual venting of the gas must represent a very large item of expense in the operation of such a ship as "Shenandoah."

The Automobile in the Test Tube

SATISFACTION is not for the research engineer. The moment he becomes satisfied he ceases to work; conversely, the more dissatisfied he is with things as he finds them the better the job he is going to turn out. A critical pessimistic but withal, a true appraiser of relative values, this research person who only too often is called in on a problem at the eleventh hour by the worried industrialist to save a very sick product.

Now the modern automobile is by no means a sick product. Far from it the automobile is a great commercial success. It has become an everyday necessity as well as a means of enjoyment. And because of its enormous popularity the public has come to accept the present day automobile as a highly developed finished virtually unimprovable piece of mechanism. True there might be certain refinements and even radical changes in certain features, such as the traffic transmission, the four wheel brakes, the balloon tires and so on, but so far as the basic design of the automobile is concerned it has been considered as solid as the Rock of Gibraltar.

Somehow or other the research engineer has been given an opportunity to place the modern automobile in a test tube, figuratively speaking. In analyzing the matter the research engineer has made numerous discoveries. For one thing, he has taken up the features of the modern automobile one by one and determined whether they were fundamentally correct or merely based on custom. That procedure has been the opening wedge. Just as it is in any research work. Doing the same thing in the same old way year after year does not meet with the research engineer's docile acquiescence.

Then too the research engineer has tried a little chemistry on the automobile. He has studied what actually takes place in the automobile engine cylinder and has learned that there are two distinct kinds of explosions—one a violent detonation which cannot be harnessed and which is therefore undesirable because it produces a "knock," the other a gradual expansion which is harnessed and converted into driving power. Chemistry has shown the way to eliminate the "knock" of the violent explosion in the form of a teaspoonful of "dope" for each gallon of gasoline used. "Doped" fuel it is said will permit the use of higher compressions in automobile engines and higher compressions in turn will result in smaller engines for a given power. Chemistry, too, has been applied to the carbon deposits in cylinders. The real nature of carbon has been determined and now we are about to have a carbon remover which really removes carbon.

The mechanical side of the automobile has been studied revealing much that is merely a matter of custom. The three-speed gear shift alone is a challenge to the research man, and he has promised to answer in due course. The cooling of automobile engines by means of water jackets and radiators is another feature which the research man refuses to accept as a fundamental, and already he has worked out ingenious ways and means of welding copper ribbons to cast iron cylinders for efficient air cooling operation—doing one of those things that can't be done.

The automobile is in the test tube. Shortly we may expect still more startling developments than those already displayed to an appreciative public because the research engineer is on the job.

Our Psychic Investigation Advances

We Find a Medium Whom We Cannot Characterize as a Conscious Fraud

By J Malcolm Bird, Secretary to the Committee of Judges

The medium, as tied for the third sitting by Houdini From these bonds no escape was possible Note seal between chair and baseboard

NINO PECORARO is an Italian youth of 24 a native of Naples and for several years a resident of New York In both cities he has enjoyed the patronage of Dr Anselmo Vecchio who was physician and friend to Eusapia Palladino the medium During her last illness Palladino promised to return to Dr Vecchio

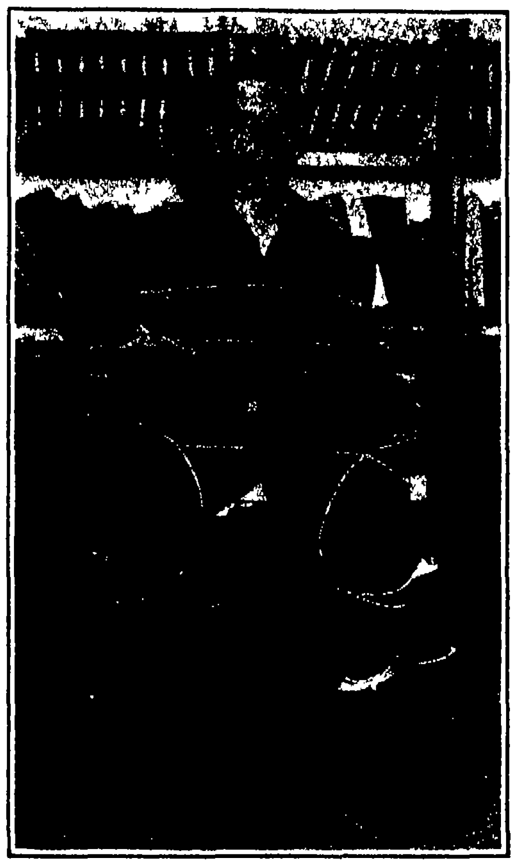
Having accidentally discovered in Nino what he took to be mediumistic powers Dr Vecchio took charge of him with the idea of developing him to a point where Eusapia could use him The result can best be indicated by an outline of a typical sitting with Nino In this it is obviously convenient to speak as though all that occurs were conceded to be genuine

Nino is clothed in garments which have been searched and tied into a chair with the idea of making it impossible for him to get effective freedom of hands or legs In the cabinet half a yard or so from him is placed a table or another chair with bells tambourines, trumpet etc A faint red light is in the room After a short time snoring is heard, followed by a whispered voice in Neapolitan dialect Palladino's sole mode of speech The sitting consists in good part of conversation between Palladino and the doctor who translates when there are English speaking sitters occasionally other controls slip in for a few words On the physical side all the apparatus is freely used and in addition there are raps and hand clappings Most of this comes in response to direct request from Dr Vecchio but a good proportion is spontaneous Sometimes there is an attempt at materialization of hands or production of ectoplasm outside the cabinet Palladino promises everything in the psychic catalog with the utmost recklessness so that even the doctor does not take her seriously here

At the end the condition in which the bonds are found is highly variable Once they were cut into fragments and piled in a corner with the medium quite free whereupon Nino having been searched Dr Vecchio pronounced the demonstration as his most marvelous achievement the implication being that he had been freed psychically Usually, I believe the ropes are considerably disarranged This is more significant with Nino alone in the cabinet and free from all control save that of his bonds than with a medium like Powell (SCIENTIFIC AMERICAN August 1923) who gives good control by the sitters in addition to that of the ropes

When the ropes approximate their original condition objection may be entered to the method of tying usually employed The medium wears heavy mittens, each of which is sewed, all around to the coat sleeve The arms are then placed together horizontally each hand at the opposite elbow and around this ensemble wire is wrapped from end to end It seems probable that the medium could free his shoulders from his coat as a preliminary to removing hands and arms bodily from gloves and sleeves, and that the wire would then insure the permanency of this assembly until he was ready to return to it When I have sat informally with Nino the coat has been of such cut fit and material as to support this suggestion

Some time after Palladino's death Dr Vecchio missed $35, under inexplicable circumstances He asked her through Nino what she knew about it and she said she had stolen it explained for whom she wanted it, and promised to repay it in installments through Nino She has made several payments, totalling $16, so she still owes $19 In his psychic scrapbook the doctor has preserved all the one-dollar bills obtained, together with numerous other apports but a ten which she is stated to have paid on one occasion is missing—



The ropes as they looked at the beginning of the second sitting

the doctor is no millionaire The ones are perfectly good dollar bills If genuinely psychic they are apports and not materializations So Eusapia may get in difficulties with the police but not apparently with the Federal Secret Service

Well the major basis for regarding Nino as a physical medium lies in his manipulation of the bells tambourine and trumpet How is this done? Nino is of course, in trance and doesn't know Dr Vecchio is clear that it is engineered by Palladino, but he makes no suggestion covering the *modus operandi* Aside from outright fraud there are four hypotheses which though they will impress some as absurd are valiantly supported by others

I That Nino remains in his bonds the work being done by ectoplasmic structures extruded from his anatomy and returned at the end of the sitting

II That by a process of dematerialization and reassembly defined no further than these words define it Nino's members are freed without disturbing the bonds used as the physical tools of the sitting and restored to their original status in a manner matching their removal

III That such release and return is effected not by dematerialization, but by passing into the fourth dimension, which this hypothesis presents as a physical reality though not defining it with any precision

IV That the phenomena are produced by an externalization of energy rather than of matter the obvious analogies being with the light wave and the radio impulse

All these theories have some connection with spiritualism but it must be emphasized that if any of them is realized it is psychic regardless of the nature and identity of the operators Psychic, we recall, means nothing more than "not yet understood"

If we find the apparatus marked with the medium's finger prints, if we smear it with some sticky substance and find this on the medium If an electric circuit is closed through the medium's body and the bell, if in any other way we show that the medium has handled the apparatus directly—then Hypotheses I and IV are ruled out We may not be so confident about II and III however Indeed, one might wonder whether it is possible to convince a spiritist that, in any given case fraud rather than dematerialization or the fourth dimension, has been at work However one attempts this discrimination, it involves a very nice balancing of facts, inferences and probabilities For instance when one has tied the medium so that one hopes he will be unable to get any slightest use of hands, feet mouth knees, chest muscles, toenails or eyebrows shall total failure of physical phenomena be laid to success in ruling out fraud or to bad psychic atmosphere? It is easy to jump at an answer to this question, but far from easy to demonstrate that the answer thus obtained is the correct one

This problem as presented by Nino's case, was brought before our committee in December We sat on the 10th 14th 18th and 21st in our law library The committee and the SCIENTIFIC AMERICAN were represented by Dr Prince Dr Carrington, Houdini Mr Lescarboura and myself Outside aid was had from Dr Siegfried Block neurologist, and Drs. G B Stearns and W J S Powers general practitioners whose observations and opinions were of great value

At the first sitting we had a very large cabinet, nine feet by four The medium wore his own one-piece undergarment and Dr Block's overcoat Gloves and wire were used on his hands and arms as described above The right glove was sewed to the coat sleeve the left to that of the undershirt The rope used to tie Nino into the chair was too hard for best manipula

(*Continued on page 115*)

At the end of the second sitting, there was every indication that there had been a partial attainment of freedom

Our Abrams Investigation—V

A Statement of Our Findings to Date and the Prospects of Further Demonstrations and Tests

As Reported by Austin C Lescarboura

Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

THE longer our Abrams investigation continues the more we begin to wonder whether we are the *investigators* or the *investigated*. Our original intention was to study at first hand the phenomena claimed for a new method of diagnosis and treatment known as the Electronic Reactions of Abrams. We fully expected this investigation to follow the usual scientific procedure which aims to establish the facts in the most direct and positive manner. We were prepared however, to make due allowances for the delicacy of such forces and variable factors as might be involved in this sensitive technique. Lastly, we had reasons to believe that Dr Abrams and other electronic practitioners and experimenters would facilitate our work in every way by extending their utmost cooperation, to the end that the truth of the so-called electronic reactions might be established once and for all.

To date, and after four months of patient and persistent investigation the tangible results are frankly disappointing. The cooperation promised us by Dr Abrams himself has so far fallen far below our expectations, for no better reason than the fact that Dr Abrams and ourselves do not agree on what constitutes a scientific investigation. Dr Abrams insists that we must visit his laboratory in San Francisco there to witness his work and become familiar with electronic technique. He has impressed this view on many of his followers who have not failed to criticize us for our reluctance to hasten to electronic headquarters. Meanwhile we have proposed a series of blood-specimen tests, which could be conducted at this time with the minimum of trouble on the part of Dr Abrams as well as ourselves and which would be far more evidential than any series of demonstrations at the San Francisco laboratory.

We have already reported our proposal to Dr Abrams. Briefly we formulated a series of blood specimen tests to be undertaken by Dr Abrams under the same conditions as he diagnoses dozens of blood specimens received from all parts of the country and even abroad day after day. The specimens would be prepared with utmost care according to electronic practice. We would even permit the specimens to be prepared by a representative of Dr Abrams, although such procedure would weaken our rigid test conditions to some extent.

The long and short of the matter is that Dr Abrams, thus far, has refused to undergo a series of blood-specimen tests, on the grounds that his findings could not be compared with clinical diagnoses inasmuch as the two kinds of procedure do not agree. This is rather puzzling at this time, inasmuch as the various disease "rates" were originally determined by taking known clinical cases and working out their electronic values. Today, however, the electronic diagnosis and the orthodox diagnosis very often fail to agree, for the reason, we are told that they are based on divergent techniques. If "A" once equalled "B," at this time "B" no longer equals "A" yet we are asked to accept the established "rates" for various disease conditions as final. Furthermore, we are asked to believe that the electronic diagnosis is far more critical than orthodox methods, so that it often discloses diseased conditions in their very incipiency, months and even years before they are developed to the point where they are disclosed by the more conventional diagnosis. Hence another reason why E R A findings so often fail to agree with the obvious facts in the case.

To make matters still worse, Dr Abrams has on several occasions asked his leading men not to make tests for us. Several weeks ago we went to considerable trouble to formulate a blood specimen test which was of the most elementary character. We were to have the cooperation of a New York doctor who is friendly to the E R A cause, supervise the preparation of the blood specimens. These specimens were to be taken from patients in the last stages of tuberculosis cancer syphilis and perhaps one or two other common causes. There could be no question regarding the accuracy of the clinical findings—indeed any layman could determine at a glance the true nature of each case. Further more to make the test still more convincing and to eliminate, if necessary the comparison between electronic findings and clinical findings we were prepared to submit a number of specimens from the same patient so as to determine whether the E R A. diagnostician would check up successfully on his own findings. Finally to simplify the matter still further the E R A diagnostician was to be furnished with a list of the several diseases represented by the specimens as well as the number of similar specimens. What could be simpler and fairer? How elementary compared to the everyday wonders of E R A diagnosis!

Just as we were on the very threshold of making a genuine test with a genuine E R A diagnostician under genuine E R A conditions our hopes were suddenly and unexpectedly shattered by word through the diagnostician's representative that Dr Abrams had telegraphed the diagnostician, *forbidding the test*. Our disappointment was beyond description. Nevertheless, this case is typical of the general evasiveness of E R A men and E R A technique in the matter of submitting themselves to honest sincere convincing investigation. More than one investigator has lost all patience in trying to get to the bottom of the electronic reactions of Abrams, and has given up the subject in utter disgust.

One word regarding a visit to the San Francisco laboratory of Dr Abrams. We appreciate the invitation. We may yet avail ourselves of same, if it is found to be a necessary procedure later on in our investigation. However for the time being a visit to the San Francisco laboratory is quite unnecessary and beside the point. We are interested first and last in the electronic reactions from a drop of blood—in the technique itself—and not in Dr Abrams himself except in so far as he practices the electronic technique. Dr Abrams, if we understand the matter correctly by no means has a monopoly on the electronic reactions, and he has taught several thousand doctors how to elicit and interpret the reactions. That being the case we feel called upon once more to state that we can test the validity of E R A claims with the cooperation of any skilled E R A worker.

Meanwhile we are severely criticized by E R A workers and their patients. Why do we not accept Dr Abrams claims without further ado inasmuch as no further evidence is required? Why bother with a scientific investigation when tens of thousands of cured patients present undeniable evidence of the efficacy of E R A? Why do we hesitate to go to San Francisco when we have been so persistently urged to do so? Why do we wish to prevent this great truth from being revealed to suffering humanity? And so it goes. Assuming, for the sake of argument that E R A is a genuine technique, the world at large must wonder why so many obstacles and so much confusion are cast into the very face of all investigators.

In his last letter to us Dr Abrams announces his departure for the East early this year at which time he promises to place his methods before unprejudiced scientists in the same way as other innovators have done. This, to our mind will do much to clarify the present unfortunate situation. Pending its realization we have no further comment.

As regards E R A practitioners in general we have had nothing in the way of tests with the single exception of the Dr X episode reported in our November issue. What is more E R A practitioners are now organized into various societies and associations for the purpose of closer cooperation among themselves. As a consequence individual E R A practitioners have been discouraged from cooperating with us as individuals. From now on all official cooperation with the SCIENTIFIC AMERICAN Abrams Investigation Committee will have to come from a committee duly appointed by the respective electronic organizations. While we may be successful in receiving some cooperation here and there from individual practitioners it is certain in advance that such practice will be discouraged by E R A and the results if detrimental, will be repudiated.

At least one of the E R A associations is going about this work in a business like manner so it seems. All its members have been queried by means of an elaborate questionnaire, regarding their appraisal of E R A claims and provable possibilities. The consequence so far is that many of the more fantastic E R A claims have been denied, and we are slowly but surely getting down to the bedrock of the matter.

As for our four months of investigation we have accomplished more than would appear from surface indications. As the results of numerous interviews demonstrations studies of case histories discussions with E R A workers and E R A investigators and E R A experimenters we have established definite findings regarding E R A which are published in the accompanying list. These findings stand as stated here unless they can be shattered through tests or positive proof to the contrary. For the most part these findings are in full accord with the beliefs of the more conservative E R A workers themselves.

AFTER four months of patient and persistent labors, our Abrams Investigation Committee inclines toward the following conclusions based on tests, demonstrations, observations, and statements given in interviews and correspondence with Dr Abrams and his followers, as well as non-E R. A electronic practitioners

1. **The public over-estimates the diagnostic and curative powers of E. R. A. Electronic workers admit that its possibilities are far below the fantastic claims set forth by *enthusiastic writers of E R A literature***
2. **If E. R. A. is a genuine technique then it is in its very infancy—crude uncertain at times, and subject to changes from month to month much as a laboratory experiment.**
3. **E. R. A does not take the place of older diagnostic methods according to numerous E. R. A workers. Quite to the contrary it may be employed only as an accessory in which connection it is claimed to be useful.**
4. **Assuming that the so-called *electronic reactions do occur and that they represent* recognizable and determinable rates: the correlations claimed between these rates and certain pathological conditions are by no means proved. The assumption that a *rate of 57 corresponds* with a syphilitic condition 42 with a tubercular one etc is admitted by persons high in the E R A councils to be entirely empirical**
5. **E. R. A. diagnosis is seemingly such a delicate procedure and is *fraught* with so many detrimental factors and variables that there is an ever present danger of grave error. The preparation of blood specimens the condition of the reagent and diagnostician and *other factors are claimed to have a marked* influence on the accuracy of the E R. A findings**
6. **All E. R. A practitioners are by no means competent to make a satisfactory diagnosis. Many of them have proved unreliable in this work. Few of them are qualified according to E. R. A admissions to undertake a scientific test aimed at appraising *the value of this technique. When one seeks a competent and authoritative test of* the Abrams technique on the basis of which judgment may be formed as to its validity one is told that the only person competent to undertake the work is Dr Abrams himself. No other practitioner is competent to make a determination on which Dr Abrams seems willing to have his system judged yet every day his authorized disciples all over the country make thousands of determinations upon which the lives of their patients depend.**
7. **Spectacular features such as determining the race of an individual his religion his exact location at the moment of diagnosis his emotions and matters of the heart are not to be taken seriously**
8. **There is a tendency on the part of E R. A workers to modify the claims made for the oscilloclast treatment. It is not claimed to "cure" in the usual sense of the word. It does so it is claimed reduce the potentiality or "ohmage" of the disease energy. Whether or not a "cure" *is effected following* the *oscilloclast treatment* is a matter for nature's own forces which are now given an opportunity to function if we accept E R A beliefs.**
9. **There is a grave discrepancy between the crudity of the Abrams apparatus and the extreme refinement of the results claimed from its use. As a specific example the resistance boxes *used have an uncertainty* in the *precise establishment of contact* between switch lever and contact point greater than the ohmage difference between successive points yet readings are made with the utmost confidence. In other respects too the accidental error involved in the use of such crude apparatus would seem to be greater than the differential between the rates etc to be determined.**
10. ***There is much confusion in electronic ranks regarding* the basis for their technique. Dr Abrams and his followers have been using the terms electrons ohms waves phase and so on rather loosely. Some are beginning to realize this fact**
11. **E R A is not a satisfactory subject for a scientific investigation. Numerous obstacles are placed in the path of investigators until patience is taxed beyond the utmost limit. Promises upon promises are made while precious time which might be put to other use is being lost. Yet all the while we are assured that E R A desires to prove its case to the scientific world through an impartial and truly scientific body of investigators. We have presented E R. A *the opportunity*. Will they accept it?**

What Is Sleep?

OMITTING all confusing detail, sleep may be defined as a periodically recurring state of the animal organism during which all conscious activities are suspended From the viewpoint of science however, this definition is not satisfactory because it is incomplete. It gives merely the negative characteristic of sleep the absence of conscious activity without stating what actually takes place during sleep That sleep is necessary to the animal organism was common knowledge, learned from experience many thousands of years ago, but even now the mystery of the why and wherefore of sleep remains partly unsolved.

In a general way it was recognized long ago that sleep is a period of rest during which the body recovers the vitality depleted by the physical and mental activities during the preceding period of awakeness and the various tissues regain their normal state by the elimination of waste products and the building of new tissue The exact nature of the chemical and physiological changes involved in this process of restoration has been studied with great care in recent years and many important facts have been ascertained which throw interesting light upon the metabolism of the animal organism and, more specifically on the part assigned by nature to certain glands.

One of the most important discoveries was made in the course of investigations concerning the pre-natal life of the human infant It was found that neither the blood nor any other part of the human foetus contained even the slightest trace of free iodine, excepting in the imperfectly developed thyroid gland As it was already known that it is one of the functions of that gland to extract iodine from the blood and to supply it when and where it is required to counteract the toxic effect of the poisons and waste products generated or cast off by the tissues of the body during labor, the absence of free iodine in the unborn child led to the inference that a definite relation existed between that fact and the restful period of nine months of unbroken sleep which the child enjoyed previous to birth It was found that the muscular effort of the new born child's first cry immediately stimulated the thyroid gland to send a supply of the powerfully anti toxic iodine through the body of the child counteracting the poisonous effect of the fatigue products generated by the activity of the muscles and other tissues involved.

It is well known that infants, during the early part of their life, require a great deal of sleep far more than the mature individual This may be accounted for by the fact that in the new born child the thyroid gland is imperfectly developed and, therefore incapable to supply an adequate amount of iodine The gland soon becomes exhausted, the fatigue poisons paralyze the nerve center and the infant falls asleep During the long period of rest the thyroid gland accumulates a new supply of iodine with which it can provide the organism during the next period of awakeness As the child grows older, the power of its thyroid gland to supply iodine increases, brain and muscles of the child become capable of greater exertion without fatigue, because the gland can send more iodine into the system to counteract the effect of the poisonous fatigue products and, as a result, the child requires less sleep. A child whose thyroid gland is defective and does not supply iodine will necessarily remain physically and mentally inferior

The results of recent research seem to indicate that different types of men require different amounts of sleep and that the amount depends in a large measure on the relative balance between the thyroid and the suprarenal glands on one hand, the pituitary body and the sexual glands on the other The adrenalin secreted by the suprarenal glands has a strongly stimulating effect on the thyroid gland and its secretion of iodine and, at the same time, causes an increase of blood pressure by the contraction of the blood vessels. Men whose suprarenal and thyroid glands are healthy, and act in efficient harmony are invariably high-strung mercurial, mentally and physically extremely active and require much sleep. Their thyroid glands send an abundance of iodine through the system to counteract the poisonous products of muscular and mental fatigue, but, having become exhausted by the exacting demands on their ability to supply iodine, they require a long period of restful sleep to recuperate Adults of that type usually need from eight to ten hours of sleep

The extreme contrasting type which is found among the northern races, requires, as a rule less sleep. His physical and mental activity is slower and less intensive and makes comparatively less demand on the iodine resources of the active and efficient thyroid gland. Men of that type are usually of larger and more powerful build than those belonging to the southern races. Though slower in their physical and mental activities, they are by no means intellectually inferior Their life processes move more slowly, their energy is less rapidly used up and they often retain their faculties to a great age.

In the light of the results obtained by recent research, sleep may be defined as a periodically recurring state during which all conscious physical and mental activities are suspended as the result of the toxic effect of the fatigue products accumulated in the muscle and nerve tissue and of the inability of the exhausted thyroid gland to supply the iodine required to counteract the paralyzing effect of the fatigue poisons. As no further fatigue products are produced during the period of rest, the thyroid gland, continuing its activity, is enabled to catch up with the demand for more iodine and to accumulate a reserve supply

Man's Erect Posture

THE *British Medical Journal* for March 17 contains an article by Sir Arthur Keith, on "Man's Posture Its Evolution and Disorders." Sir Arthur points out that extinct forms of man indicate that the upright carriage of the head was evolved later than the human form of the lower limb, of which the origin must be sought in Miocene or possibly Eocene times. Three phases of evolution are distinguished. In the hylobatic phase the gibbon was differentiated from its cousins, the Old World and New World monkeys, by postural adaptations of bones and muscles in virtue of which it was orthograde and human in type as opposed to the pronograde monkeys. This differentiation probably took place towards the end of the Eocene period. The troglodytic phase was represented by the great anthropoid apes, evolved from the small anthropoids probably in pre-Miocene times In the planti grade phase, structural changes were confined almost entirely to the lower limbs Seeing that man shares so many characters with the great anthropoid apes, the author held that man is one of several aberrant branches of one great stem which began to break up into the various fossil and living forms at the beginning of the Miocene or the end of the Oligocene period

How Hafnium Was Discovered

THE recent discovery of hafnium the latest addition to the list of chemical elements, is a remarkable illustration of the wonderful possibilities which rest in the scientific application of deductive methods of research in chemistry The story of the discovery is a veritable romance of science

The discovery of hafnium which was named in honor of Copenhagen, the capital of Denmark (called Hafnia in its Latin form) was not an accident but the result of investigations based upon deductions from the latest and most advanced conceptions of atomic structure made possible by the discovery of the X rays by Roentgen, the invention by von Laue of a method of obtaining a spectrum of the short wave invisible light rays with the aid of crystal gratings, and the ingenious theories concerning the periodicity in the arrangement of the elements and the internal structure of the atoms contributed by Meyer Mendelejeff Rutherford, Bohr and the late physicist Moseley, who met with an untimely end in the trenches before Gallipoli during the great war

In 1869 Mendelejeff and Lothar Meyer presented to the scientific world their discovery that the elements, when placed in the order of ascending atomic weight, showed a remarkable regularity of periodic nature, each element resembling most closely the eighth element beyond or before it in the list From the results of subsequent investigations the conclusion was drawn that all the properties of the elements are periodic functions of their atomic weights Certain irregularities and inconsistencies in the periodic system could not be satisfactorily explained, but the fact that three of the blank spaces in the periodic system were afterwards filled by the discovery of gallium scandium and germanium, which showed physical and chemical characteristics closely corresponding with those that Mendelejeff had predicted for the then unknown elements, strongly supported the soundness of his theory and the significance of the periodic table

The discovery of the Roentgen rays opened a wide field of research concerning the internal structure of the atoms which, until then, was merely a matter of scientific speculation In 1912 Dr Laue of the University of Zurich discovered that the invisible X rays could be refracted by means of a crystal grating to give a spectrum that could be made visible by photography Two years later Moseley, using different elements on the anti-cathode of the X-ray tube, found that the higher the atomic weight of an element, the shorter is the wave-length of the characteristic X rays. He also found that, when the elements are arranged in the order of these wave-lengths, whole numbers can be assigned to each which are inversely proportional to the square roots of the wave-lengths of corresponding lines in their X ray spectra. These numbers are called the atomic numbers of the elements.

Later, a simpler interpretation of the physical significance of these numbers was found, in terms of their electronic structure. Bohr, a Danish scientist, elaborating Rutherford's electronic theory of atomic structure, developed the doctrine that each element has as many planetary electrons in its atom as there are units in its atomic number The nucleus, according to this theory, contains both negatively charged electrons and positively charged protons, with an excess of the latter, and about it there rotate orbitally enough "planetary' electrons to strike a balance between protons and electrons for the complete atom Hydrogen, for instance with the atomic No 1, has only one planetary electron in each atom; helium, atomic No 2 has two, and so on up to uranium, of atomic No 92, which has in its nucleus 92 more protons than electrons, and is made electrically neutral by the presence of 92 planetary electrons. No more than two electrons revolve in the orbital range nearest the nucleus, no more than eight in either of the next two, and no more than eighteen in either of the next two

The list of elements arranged in the order of their atomic numbers showed a break after No 71, the element lutecium, the last in the known series of rare earths beginning with praseodymium, No 59 No 72 was lacking and it was not known whether the unknown element would prove to be one of the trivalent rare earths or not. Accepting Bohr's theory, that the element No 72, could not be trivalent but must be quadrivalent, D Coster, a Danish, and George von Hevesy, a Hungarian chemist, working together in Copenhagen, deduced that the unknown element would probably show great resemblance to element No. 40, zirconium, also quadrivalent, to which, according to the theory of Bohr, it must be closely related

Patiently the two investigators examined the X ray spectra of all zirconium minerals and chemical combinations of zirconium obtainable and in each case they found in addition to the characteristic lines of the known element, lines of another, unknown element, in the exact position where in accordance with Bohr's theory the lines of element No 72 should be By a careful process of elimination the two scientists succeeded in separating the new element, which they named hafnium, from the zirconium, its invariable companion and obtained it in pure form It is quite common and forms approximately one one-hundred thousandth part of the earth's crust.

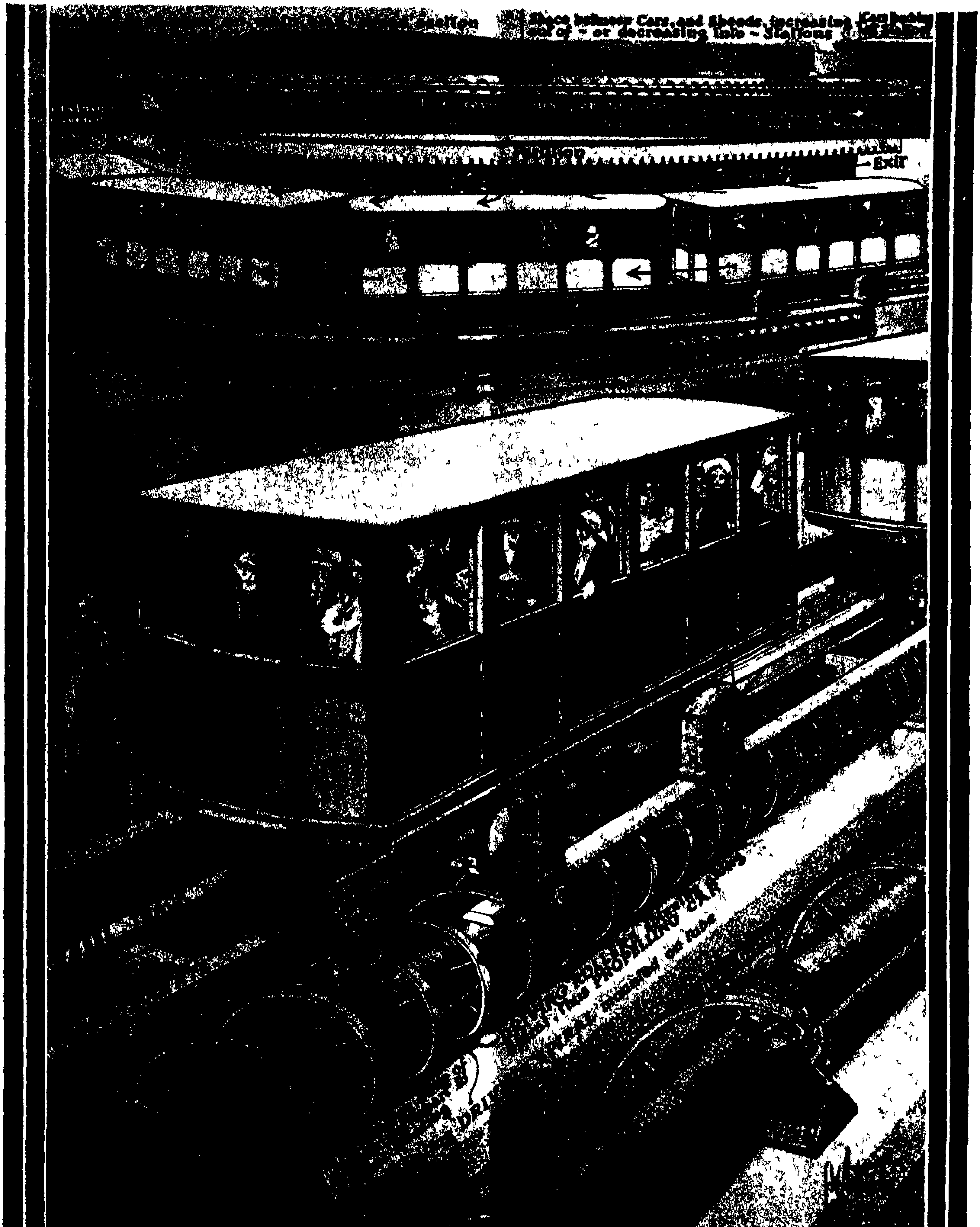
A Corkscrew Railway

AMONG the features of the British Empire Exhibition at Wembley will be a striking idea in railroad propulsion, devised by W Y Lewis and B R. Adkins. Preliminary work has been started, and the installation is expected to be complete by April. The top sketch explains how the single cars (the system permits of coupled trains when desired) close up and slow down approaching a station, creep through in contact, and again open out and accelerate in leaving—the whole cycle being very smooth

The middle sketch shows the cars at a station, where passengers merely walk in or out, the cars being entirely open on the platform side to give maximum accessibility One method of driving the spirals is also indicated, seven electric motors like the one pictured providing the railway's entire motive power

The large drawing, giving details of car and track, shows in the left foreground the ingenious bearing which is interposed without breaking the continuity of the spiral. At the right is the further modification used where changes of gradient or direction occur

Approximate details for the Wembley installation are a total of 80 cars in a 7200-foot line, a rush-service speed-range of 2½ to 20 miles per hour, obtained by rotating the spiral more quickly; six or seven stations with corresponding motors totaling some 400 horsepower, and a capacity in each car of 18 passengers seated and twelve standing. This gives a line capacity of 15,888 passengers per hour past a given point.



Drawn by our British staff artist, S. W. Clatworthy. Copyright, U. S. A., Scientific American Pub. Co.

CORKSCREW DRIVE FOR OPERATING CREWLESS CARS OR TRAINS: AN INGENIOUS BRITISH IDEA WHICH MAY BE AS PRACTICAL IN EVERY-DAY USE AS IT IS UNUSUAL.—(See facing page for details)

Remolding Our Civic Clay

How the City Planner Guides the Previously Misdirected Growth of Our Communities

By A G. Ingalls

IN "Uncle Toms Cabin, Topsy "jes grew" That is the trouble with most of our cities and it is the straightening out of Topsy that is giving employment to the members of a comparatively new profession—that of the city planners City planning suggests the laying out of new cities Or it suggests the creation of civic groups and spectacular vistas Mainly it is neither Mainly it is what might be called the re planning of existing cities so that they may be better places to live in and so that lives and money may be saved The city planner cannot cut and slash He would like to but the taxpayers cannot afford it He must coax Under his hands a city must become plastic, but the remodeling of the clay must be done slowly

The laying out of Washington D C, was a wonderful thing and a wonderful opportunity but of such cities planned from the start the city planner deals with but few Gary Indiana was such a city and so were Delhi the future capital of India and Canberra the federal district of Australia, which was laid out in the wilderness, a clean slate from the start Of such jobs there are far from enough to go around But the city planner has his living to make therefore he takes old cities that have grown up wrong and tries to right them Such work is not very romantic and not very spectacular but it pays and it is decidedly interesting in the sense that it is a struggle against perplexing difficulties

The city planner is forced to make the best of what he has to work on He cannot ask taxpayers always to indulge him in the most highly desirable solution of a given problem, because pretty often they can t and won t afford it Knowing this he takes the next best solution and somehow makes a go of it While he is on the job he does all that he can get sanction for and before he goes he leaves with his client a detailed plan which represents an ideal or distant goal for its citizens to work towards Then as the years go by and the city planner gets old and dies and property deteriorates enough so that it may be torn out the right changes may be made Lacking such a definite and agreed plan as a common focal point for many minds people will always work unconsciously at cross purposes and thus our cities will remain hodgepodges without system The time to catch them is when they are young "As the twig is inclined, so the tree is bent"

Sooner or later the people of most communities arrive at the conviction that their physical environment is growing up wrong, that it is slowly crystallizing in forms that are hard to alter but which nevertheless must be altered The job will never get easier It will always become harder Something must be done about it they decide and so the professional planner is called in to look the job over

City planning has become a profession Its members do nothing else And the experience they get in working out the problems of one city are invaluable on those of the next Yet, no two of these problems are alike Every one has to be studied on its own merits. This study is not a matter of days nor of weeks for the consultant has to get to know his patient before he can operate He makes much more of a science of it than one would be inclined at first to think In fact, the things he thinks up to investigate would never occur to most of us because we take them for granted Generally the city planner is an engineer—or he employs engineers or is in partnership with them In any case, he must and does know municipal engineering while in the matter of matching wits with politicians and people with axes to grind he has cut his eye-teeth He has made careful studies of his work both from a theoretical and a practical standpoint He has saturated himself for years in its special literature, of which there are many five-foot shelves And he has learned to catch the point of view of the average citizen of the average city without losing the sense of detachment that belongs to him because the new city is utterly strange to him at the beginning

The Municipal Building, part of Springfield's new civic plan

When he has been employed to diagnose and remedy the troubles of a community that has decided that it needs his services the city planner considers everything pertaining to the job under a number of heads These are streets transportation of people transportation of goods factories and warehouses, food supply and markets, water supply and sanitation, housing recreation parks, boulevards and tree-planting architecture laws and financing From this it will be evident that his work touches on the life of the city community almost in its every aspect and that in this regard we have come a long way from the two rather prevalent ideas that city planning is simply the laying out of new cities and the design of elegant civic centers for old ones

Typical of the labors of a professional city planner are those of a New York corporation of city planners whose members are in the business of selling technical advice to communities This corporation took a contract to improve the city of Springfield, Mass. In 1913 the principal streets of this city had become badly congested, the approaches to the big railway station were inadequate, the waterfronts were being used for undesirable purposes and the city had become a mass of billboards and advertising signs These and other matters came to a head and forced the creation of a city planning commission consisting of three city officials and five citizens. This committee set about its new work energetically and recommended several preliminary works such as the preparation of a topographic map, the widening of certain streets and the employment of experienced city planners to assist in creating a broad-gage scientific city plan In 1921, after a long delay owing to the war, the commission was supplanted by a Planning Board This board set about its task by asking two or three city planners of wide experience how they should start As a result of the advice given four leading city planners were asked to come to Springfield look over the city and write a report as to what they thought the planning board could do and, roughly how much it would cost

A little later a contract was signed with a city planner for a sum of about $40,000 to prepare a comprehensive city plan In addition, another noted city planner was retained as an advisor Working for the city planning corporation from five to forty men were employed in presenting the required data in map-making and in making diagrams, tabulations and studies as well as in the preparation of reports In all nearly four thousand maps, charts, tabulations and studies were made and 25 reports were written making up a rather voluminous report on what should be done to improve living conditions in Springfield

It was found that Springfield was typical of other cities in its growth Public garages, stores and even factories had been invading residential districts, numbers of apartment houses had been built out to the street line and to the side lot lines in the heart of the open, residence blocks where the homes had ample front and side lawns Factories had invaded dwelling and tenement blocks and had spoiled good business streets Eight story buildings had been springing up among two and three-story buildings In sum the city had been growing without order and without direction

Here, then was the opportunity for zoning In a *few years every community will regard the necessity* of zoning just as they regard sidewalks or waterworks today The purpose of zoning is simply to conserve all that is best in existing conditions and tendencies, and protect property against the harmful use of neighboring properties

In order to learn the facts with regard to the character and intensity of use and development of each individual property in the city five or six men were kept busy for months collecting this data on some 400 maps These facts covered such items as the use of

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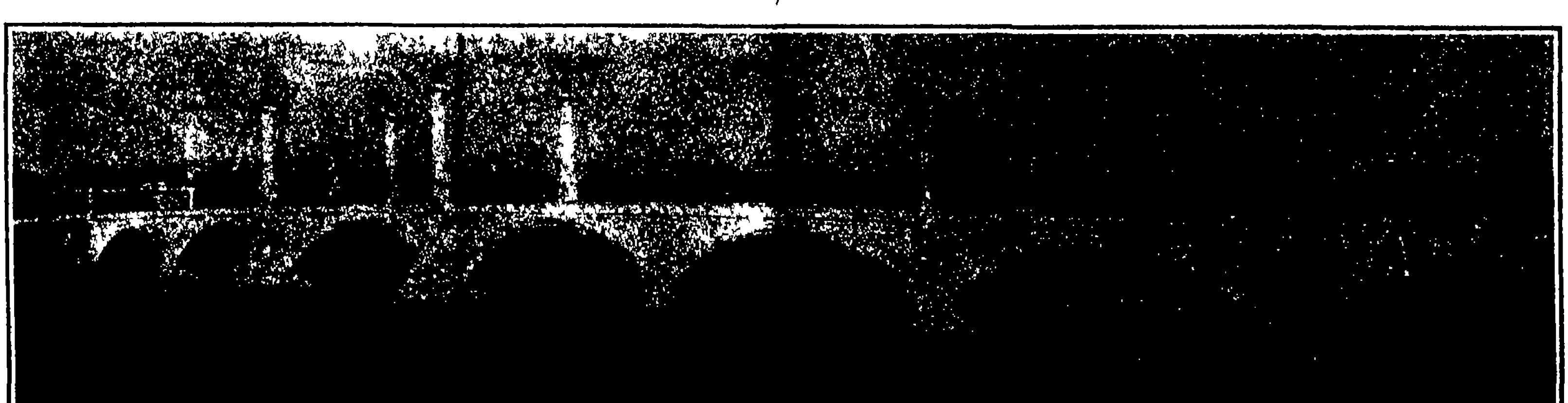
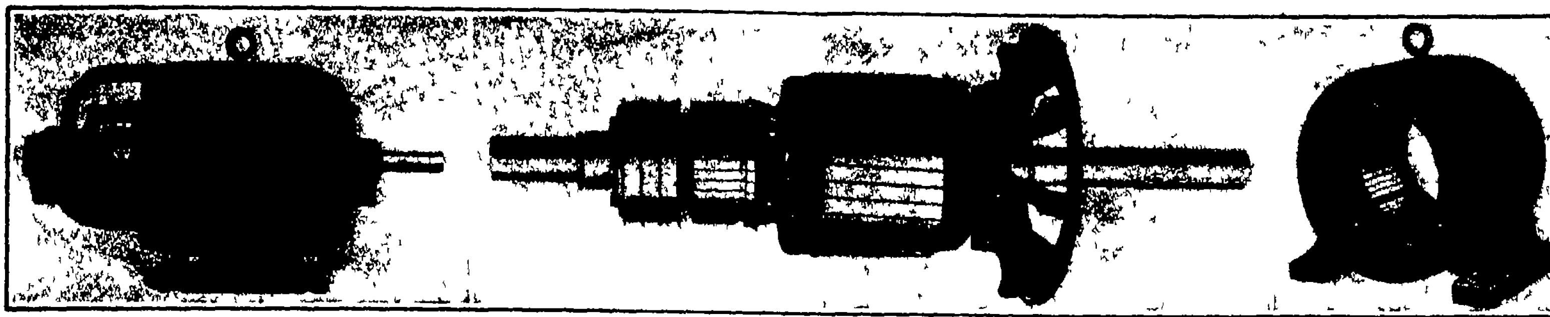


Hampden County memorial bridge, which replaced the old toll bridge across the Connecticut River at Springfield, Mass.



The new alternating-current motor which combines the advantages of former types without their disadvantages *Left* **The Fynn Weichsel motor complete** *Center* **The rotor or revolving member** *Right* **The stator or stationary member**

A Motor That Solves the Power-Factor Problem

IN direct-current work the power measured in watts is the product of the volts and amperes in the circuit. In alternating-current work, however this is only true when the current and the potential are in phase If the current either lags or leads the values shown on the volt and ammeters will not be true simultaneous values Thus the power in an alternating current circuit at any instant is the product of the simultaneous values of current and potential and the volts and amperes shown on the recording instruments must be multiplied together and their product multiplied by a power factor before the true watts are obtained

Technical as all this may seem—and it is highly technical when reduced to the cold mathematics of the thing—it simmers down to the everyday fact that power factor has an important bearing on electrical installations A low power factor on a system means greatly reduced capacity of generators, transformers, transmission lines, etc and poor regulation of the entire system It is, therefore important to keep the power factor as high as possible

Within the last few years central station managers have begun to realize more and more that a considerable proportion of their equipment is idle as far as any return on the investment is concerned, some large distribution systems showing as much as 20 per cent or more of the total investment producing no return due solely to the low power factor of the connected load One large central station alone shows an increased investment of over ten million dollars due to the low power factor of its load This is accompanied by an increase of operating costs including both interest on excessive investment and actual cost of excess losses in the generating transmission and distribution systems of approximately two million dollars Stating the matter another way, if the load on this central station were a unity power factor load—with current and potential in perfect phase—its yearly net revenues would be nearly two million dollars a year greater and this is only one of a very large number of central stations.

It has remained for an American company to develop what is known as the Fynn Weichsel motor, which is a radically new type of constant speed alternating current motor having a combination of the good characteristics of both the well known slip-ring induction and synchronous types of motors, with those features which are undesirable from both the central station and users point of view, eliminated This motor may be used as a unity power factor motor for complete installations or in combination with other motors to produce a resultant load of unity power factor

The new motor, which is shown in the accompanying illustrations, consists of a stator with starting and operating windings, and a rotor with windings carrying the load and exciting currents The rotor windings are connected to a commutator and slip rings of the usual construction Brushes, bearing on the commutator, suitably interconnect the stator and rotor windings.

The Fynn Weichsel motor has the very peculiar and desirable characteristic, if heavily overloaded, of dropping out of step and operating as an induction motor with induction motor characteristics. The value of this characteristic cannot be too strongly emphasized as it enables a motor to carry temporary excess overloads in the same way that the squirrel-cage or slip-ring induction motor will carry overloads thereby making the motor just as stable and practical in its operation as present types of induction motor The motor has the still further peculiarity that when the excess overload is removed the motor will again operate at synchronous speed—obviously a feature of the greatest value

Making Plants Work Overtime by Means of Electric Light

THE value of electric light for accelerating the growth of plants was conclusively proved in a six weeks test recently completed by the Westinghouse Lamp Company During the tests which were conducted in cooperation with Peter Henderson & Company, seedsmen, at the Henderson proving grounds at Baldwin L I, many of the specimens exposed to electric light grew to approximately twice the size of similar plants receiving daylight only and were considered by experts to be from 14 to 27 days in advance of normal growth Similar results were also obtained in preliminary tests conducted by the Westinghouse Lamp Company at Columbia University under the direction of Professor Hugh Findlay of the Department of Agriculture of the University Two 110-volt farm lighting plants were used to supply the power for the Baldwin experiments showing that the use of artificial light for forcing plant growth is not restricted to localities where central station power is available but may be undertaken wherever current of any sort exists

On September 1st twelve varieties of vegetables and twelve of flowers were sown in shallow (three inch) boxes, or flats as gardeners term them The soil used was ordinary light sandy soil such as is generally used for starting seedlings Two sets of flats were sown one set for growing under artificial light and the other for growing with daylight only The following varieties of vegetable and flower seeds were selected for the experiment

Snowball cauliflower easy blanching celery tender green bean bush lima bean French forcing carrot Davis perfect cucumber butternut lettuce scarlet giant radish, Egyptian beet Rocky Ford muskmelon bonny best tomato golden heart endive Transvaal daisy orange calendula blue lace flower baby's breath snap dragon lavender African daisy impatiens mignonette wallflower cineraria begonia aster

Both sets were grown under identical conditions of heat and moisture on opposite benches When the electric lights were turned on an oil cloth curtain divided one group from the other The light was switched on every night at 8 P M and shut off automatically at 1 A M

Almost from the outset there was a marked difference noted in the germination of the seedlings under the electric light Germination was hastened in some cases, as in the beans celery lettuce and endive among the vegetables and calendula gysophila (baby's breath), antirrhenium (snap dragon) mignonette and wallflower among the flowers to the extent of four to 12 days depending on variety The advantage gained with the advanced germination was maintained in every case through to the end of the experiment In some cases there was no perceptible gain in growth, particularly in the root crops including beets carrots, and radishes

That there is a certain analogy between the radiant energy of sunlight and that of an incandescent electric light was definitely established by the fact that the chlorophyll was more active in those plants which received the additional light The foliage presented a richer greener more turgid and vigorous appearance than that of the plants that were denied the advantage of additional light Also in the case of the vine crops cucumbers and muskmelon, the stems of the plants were heavier and stockier than those of the plants grown without the electric light In this experiment the fact was established that all plants presenting a large leaf surface are greatly stimulated by the supplementary use of electric light Particularly good examples of this were afforded by the leaf crops such as lettuce and endive

The tests indicate that electric light will be useful to florists and gardeners in forcing flowers for definite dates such as Christmas and Easter and in reducing the time required for seedlings to grow large enough for transplanting

No use of artificial light, in addition to that involving the eye can be of greater benefit to humanity than this recently developed application to the stimulation of the growth and development of plants and vegetables says Samuel G Hibben National Secretary of the Illumination Bureau of the Westinghouse Lamp Company under whose direction the investigations were conducted In a general way we have known that artificial light influences the growth and flowering of certain plants but no well organized research work has been done until recently to prove whether the application of electric light was commercially feasible as a means of supplementing daylight We now know that this stimulation of growth does not necessarily require the same intensity of light as daylight nor does it seem necessary to reproduce exactly the color qualities of daylight We know furthermore that plants must rest, and that the application of artificial light is advisable only during carefully chosen hours when daylight is inadequate Its use to impose a twenty-four hour day upon the growing plant would be as disastrous as a similar effort in the case of human labor

What this development means to the agriculturist is hard to predict It seems however to promise a means of doubling the speed of development of many species and bids fair to enable the horticulturist to bring his flowers into bloom at the time when their market is at its best This has all been made possible by the perfection of flexible and cheap sources of light and in it are contained advantages that seem as sweeping in their prospective benefits to humanity and as far reaching in their scope as anything that has happened since Luther Burbank developed the Shasta daisy or spineless cactus.

A battery of 500-watt electric lamps used to prolong daylight by artificial means and thus force plant growth

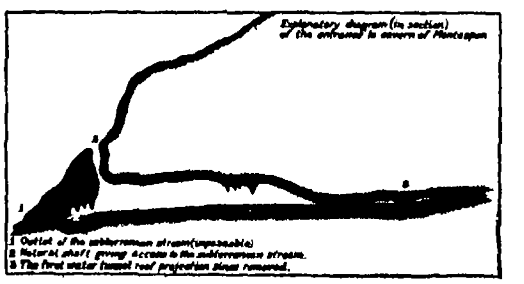
Animal Sculpture of 25,000 Years Ago

The Recent Discoveries in the Water-Blockaded French Cavern of Montespan

Photographs Copyright by *Illustrated London News*

Preparing for the plunge into the icy waters of the subterranean stream

A MOST important discovery has recently been made in southern France which shows that if in the Stone Age man were still ignorant of the art of making pottery by baking earth they had at least discovered its plasticity and used it to model figures of animals doubtless for purposes of magic The story of the discovery reads like a fairy tale A young French archæologist M Norbert Casteret entered what appeared to be the mouth of a cave and swam alone through a subterranean stream 1900 yards long He carried matches and a candle in a rubber case and by alternately diving and swimming he reached a great 220-yard gallery in the heart of a hill containing numerous works of prehistoric art The sculptures—figures of animals modeled in clay—included a bear three tigers three horses and 20 modelings of uncertain character The rock engravings of animals twenty six in number are possibly the first writing of the cave men



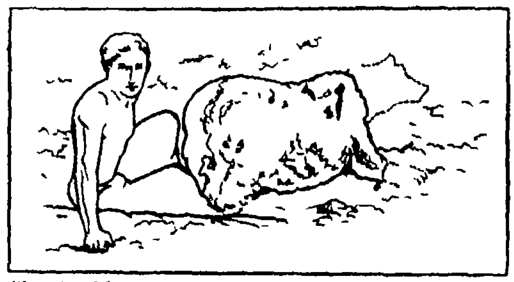
Montespan—The cavern's mouth and the subterranean stream

A more daring feat cannot be cited in all the annals of exploration The discovery took place at Montespan in the Department of Haute Garonne, France Work was at once carried on to reduce the water level so that access was rendered easier and our always progressive contemporary beyond the sea, *The Illustrated London News* dispatched a celebrated photographer Mr H A V Coles and we show the result of his labors through their courtesy

Once through the icy water and truly in the bowels of the earth M Casteret with his feeble candle saw what had been closed to mortal vision for at least 25 000 years On the rocky walls were seen engravings made with flint implements of prehistoric animals and others that have disappeared from France thousands of years ago bison wild horses reindeer stags mules, wild goats mammoths hyenas and so on There were also visible painted in red ochre mysterious signs which represent perhaps the earliest writing of the cave men

Lastly—and most interesting of all—there were found statues in clay also representing animals Hitherto, only one discovery of prehistoric sculpture had been made in the whole world That was in 1912, when Count Begouen of Toulouse found in the Tuc d Audoubert cave in Ariege two admirable clay figures representing bisons His remarkable discovery caused a great sensation and brought to light one of the finest known specimens of prehistoric art The bisons of the Tuc d Audoubert are the work of the Magdalenians, and go back in date some 15 000 years The clay figures of the Montespan cavern are larger and in a rougher style and are unquestionably much earlier

There is a bear (which we illustrate) lying down about 3½ feet long and 2 feet high, in a natural attitude like that of the great Sphinx The body is pitted with spear thrusts and covered with layers of lime accretions, while on the left side is engraved a design too faint to be determined The head never existed—or rather, it was replaced by the skull of a bear cub, which had broken away and still lay between the forefeet



Sketch of bear showing where the head was replaced by the skull of a bear cub Detail of picture below

On the ground round the bear could be distinguished some 20 smaller models in bas-relief, rendered unrecognizable by the action of dripping water Only three horses are well preserved and suggest that the other figures were also horses The three that have survived differ notably from our modern horses having a very large belly with abundant mane and beard

Elsewhere were three large figures of tigers, affixed to the wall, much damaged and partly fallen away by their own weight They are each about five feet long and one bears on its breast the mark of numerous javelin blows All these sculptures are authenticated by layers of stalagmite deposited on them by oozing water The strangest part of it all is that all the animals had apparently been mutilated, especially in the vital parts, by somebody contemporary with the artist who modeled them This confirms the theory that these caves with models or paintings of animals were primitive witch doctors caves. They are all placed in very inaccessible spots and the animals modeled or depicted are always wounded by axes or arrows Just like the redskins or the African tribes, these people who lived 25,000 years ago must have practiced the use of magic We can imagine these men in their dark caves black with soot from their reindeer-oil lamps and clad in skins On the eve of a hunting expedition they gathered round the priests of the tribe and there stabbed and maimed the animals they feared or those they wished to catch

On a bank of clay, where there are some clay balls molded by primitive man, is also modeled half of a woman s body Apart from the mural engravings and the sculptures, this gallery, which is very clayey, is covered with traces of fingers and innumerable patterns. One can see also the places from which the prehistoric folk removed clay for the making of figures The hollows from which the clay was extracted are very distinct, and bear marks of flint implements Some of these flints are still lying there where they were put down or mislaid The walls of earth or rock likewise show traces of the scratchings of the cave bear, which also haunted this vast cavern at a time when access to it was probably easier than it is today either because there was no water in it, or because there existed another entrance which is now stopped up

A study of the sculptures in the Montespan cave points to their being the work of Aurignacians, who lived 25,000 years ago, and sought the most inaccessible caverns to devote themselves to their mysterious ceremonies. The javelin marks on the clay animal figures in the cave suggest that like certain living tribes today, the first inhabitants of this cave used to gather round the statues they had fashioned, and practice rites of sorcery and propitiatory magic to secure good fortune in their future hunting In every way M Norbert Casteret s discovery, while rewarding him for several years of toilsome and dangerous research, throws a flood of light on the mentality, manners and occupations of primitive man It is a priceless contribution of our knowledge of the origin and history of mankind

Prehistoric sculpture of a bear with M. Casteret alongside

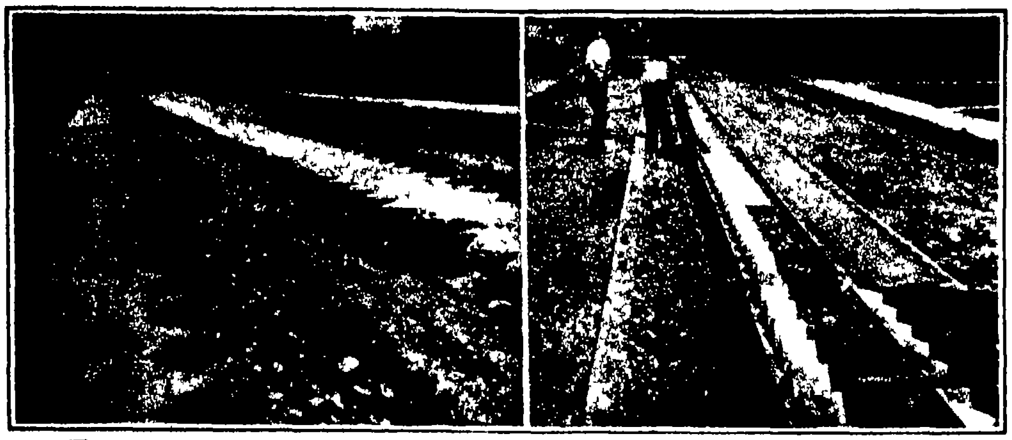
The Size of the Universe

IN an unusually interesting article in *Science* for September 7th, Professor Archibald Henderson discusses the question of the size of the universe according to Einstein s general relativity theory The volume of this universe expressed in grams is seven followed by forty-one ciphers, divided by the mean density of matter to the 3/2 power and the mass of this universe is seven followed by forty-one ciphers divided by the square-root of the mean density If we assume that the average density of the matter in the universe is the same as that of the Milky Way we find that the radius of the universe is at least 150 million light years or since the distance from the earth to the sun is 93 000,000 miles, the radius of the universe is one million times ten million times the distance from the earth to the sun Choosing the Milky Way as a 'yardstick' of 30 000 light years, according to the figure of Curtis it will take 10,000 Milky Ways laid end to end to arrive at the diameter of the universe Using the diameter of the earth s orbit as a measuring rod we shall need ten trillions of these units to take the measure of the diameter of the universe

The weight of the universe, in grams would be one followed by fifty four ciphers—which would carry us into the nonillions of grams The weight of the Einstein universe bears the same relation to the weight of the whole earth as the latter bears to a kilogram The weight of the earth to that of the sun is as one to 324 000 Hence we should have to take a trillion suns to get the weight of the universe

It would take a ray of light traveling at the rate of 186,000 miles per second one billion years to go around the universe To go around the universe it would take the fastest airplane three quadrillion years, the fastest automobile five and one-half quadrillion years, and an express train, traveling at the rate of sixty miles an hour, eleven quadrillion years.

The Twin Trails Highway



Left: The twin trails of concrete after removal of the forms but before the highway has been graded to a level with their surface *Right* Laying the twin trails Jagged forms of wood are used in order to give the serrated edge to the rails

BY substituting for a full width highway, two relatively narrow strips of concrete, Mr Robert Greene, an inventor of London, Canada, has created a new type of highway that has most of the advantages which a wide pavement possesses, and many good features which it does not possess The strips of concrete, which are ordinarily from 18 to 24 inches in width each are built between *forms* having a serrated edge These wooden forms are constructed of two by-eight inch plank to which are attached a series of triangular blocks cut from sections of six by six timber split cornerwise When placed in a trench of suitable dimensions with the serrated edges facing inward the forms are ready to pour

The twin trails type of road is suitable for any highway where the great percentage of the travel is straightaway and it is designed to use as many as four pairs of trails on roads leaving large cities where the traffic is exceptionally heavy Another manner of using the twin trails in locations where there is heavy traffic on country roads, is to provide a pair on either side of a 40-foot road with 20 feet of gravel road in the center

In farming communities especially if they are in hilly parts of the country, it is the experience of the farmer who brings a horse-drawn load of produce to a shipping point, that it is almost impossible for the horse to get traction on the slippery pavements that have been developed as a result of the growth of the motor vehicle The Twin Trails road however may have a filling of gravel or even of earth *permitting good traction for the horseshoe* One difficulty that is sometimes had by the motorist is to remount the pavement after having turned out owing to a tendency for surface water to run along its edge and cut a small ditch The Twin trails pavement according to the claims of its inventor does not develop this little rut, while the outline of the trails permits the wheel of the car to mount it without danger of skidding There have been numerous attempts made to substitute something in the way of a rail or track effect for the full width pavement but none of the previous suggestions have impressed us as practicable Mr Greene's idea seems far more likely to succeed *than anything of the sort that has gone before*

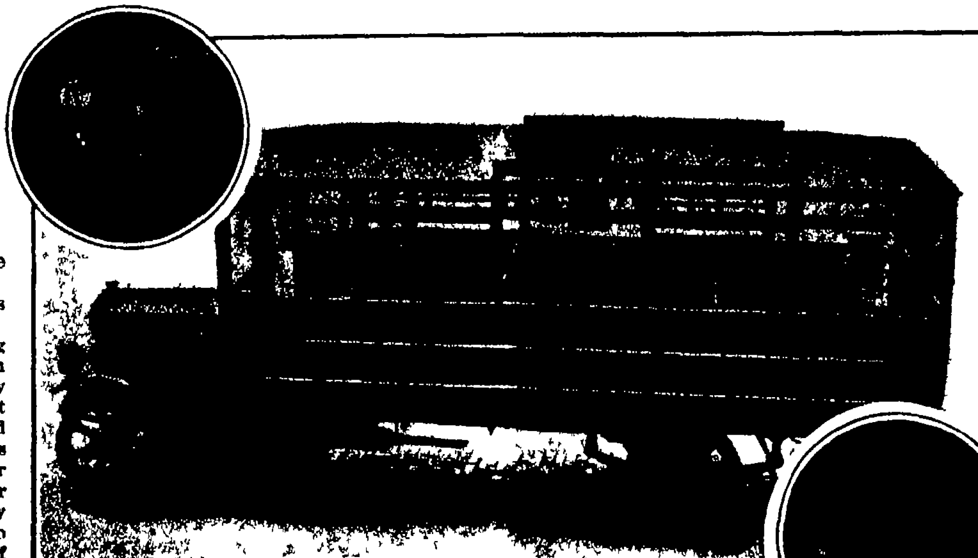
Suspending the Motor Car Body on Air

IN England, a new type of air suspension of motor car bodies is being used wherein the body floats on a peculiar type of encased rubber tubing in such a manner that it acts much the same as pneumatic tires This permits of giving the car the same resilience afforded by the pneumatic tire, while at the *same time the wheels* themselves are shod with the less expensive hard rubber tires As shown in the accompanying illustration the air suspension apparatus consists essentially of a modified inner tube built in a long straight form instead of in a circle This tube is placed in a steel channel over which another slightly wider steel channel is rather loosely fitted, permitting the desired up and down springing motion of the body of the car In short, the car body actually floats on air. The channels are bolted to the chassis side members and to the under side of the body, respectively The air tube is of circular cross-section externally but the upper or load carrying portion is somewhat thicker the thickness of the tube varying from three-thirty seconds *of an inch to one quarter* inch Either end of the tube is closed and the forward end is fitted with a union and pipe connecting with a valve and pressure gage on the dash Very low pressures are used on this new type of suspension which is known as the Holden suspension the pressures varying somewhat with the loads to be carried in the vehicle In order to prevent the nested channels from separating with the upward movement of the motor body as the vehicle passes road obstructions there is a restraining device which limits the amount of vertical movement to three eighths of an inch

Tests which were made on the new air suspension gave remarkable results A bus was used in these tests and this bus loaded with only four persons and the driver, was driven over the rough pavements of Manchester Each of the two suspension tubes was coupled to its own separate valve and gage although as illustrated the two may be joined and treated as a unit The pressures used were *only five pounds to the* square inch with the bus standing When in motion of course the pressure oscillates wildly As a test of the air suspension it was found easy to write a legible hand while covering the pavement in the air suspended bus but similar tests made on ordinary municipal buses proved that this was impossible as almost any reader would be prepared to grant without argument

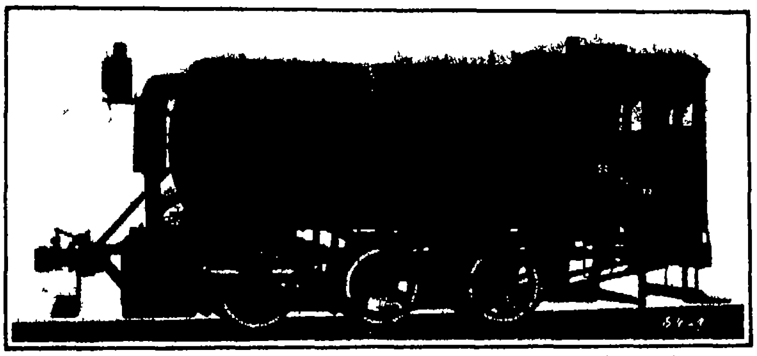
The same type of suspension has been used on street cars with $3\frac{1}{2}$ inch tubes under 10-pound pressure the whole giving a resistance to load of over 20 tons

The wear on the inner tube is practically negligible especially as the pressure under which it works is reduced by nine tenths as compared with the working pressures of the tubes in the ordinary tires Apparently it is not even necessary to encase these springing tubes in an outer shoe to get proper life



Motor bus equipped with special pneumatic suspension, in the form of interlocking channels with inflated tube between, thus obtaining air resiliency elsewhere than in the tires. Upper circle shows dashboard gage to indicate inflation of tubes, lower circle indicates rebound restraining device

Driving Locomotives with a Charge of Steam



Special steam accumulator engine devoid of smoke, gases or ashes The usual boiler is replaced by a tank in which steam is stored for subsequent use

USING a mass of hot water for the storage of steam in the form of heat is the basis of a steam accumulator which is being employed both here and abroad in a variety of ways More recently this principle has been successfully applied by the Baldwin Locomotive Works to a number of locomotives in order to meet special operating conditions This type of locomotive is shown in the accompanying il*lustration* Where smoke or gases are objectionable and electrification is unwarranted these locomotives fill a need The reservoir is filled about two thirds full of water The water is then heated from a stationary boiler to a pressure equivalent to 200 pounds per square inch A reducing valve delivers steam to the cylinders at approximately 50 pounds pressure As the steam is drawn off the heat stored in the water causes further evaporation and in part replenishes the steam supply The charge of steam or heat will usually last from three to four hours when it is again necessary to recharge the reservoir from the stationary plant It might seem that this system would suffer unduly from heat losses but it is, of course a simple matter to give the reservoir the necessary insulation

Head-Hunting in Papua

IN a recent issue of *Man* Mr E B Riley gives an account of the method of preparing the heads of enemies practiced at the village of Dorro in Papua After the flesh and brains are removed a piece of rattan cane is fixed to the bottom of the mummified skull to take the place of the lower jaw and to act as a support for the packing of the neck It was difficult to ascertain why the lower jaw is not replaced The explanation seems to be that they prefer to hang this up in the house and keep it as a mark or token of the owner's prowess in war after the mummified head has decayed but the lower jaw is sometimes replaced being tied to the zygomas as with *the rattan cane* Finally the head is dried being fixed on a wooden framework over a fire lighted for that purpose and the hair is pulled out as decomposition of the skin advances

High Explosives that Will Not Freeze

Cold-Proof Powders that Eliminate the Dangers of Thawing Dynamite

WHEN Ascanio Sobrero an Italian chemist, discovered nitroglycerin in 1846 he gave to the world the basis for high explosives. Although gun cotton had been prepared prior to this neither gun-cotton nor nitroglycerin were of any commercial value on account of being very unstable. About 15 years later, Alfred Nobel, a Swedish engineer mixed nitroglycerin with kieselguhr an infusorial silicious earth formed from the minute fossil remains of animalcula and produced dynamite which was more stable than nitroglycerin but which still possessed the property of becoming chilled or frozen at comparatively high temperatures around 50 degrees Fahrenheit. When in this condition nitroglycerin dynamite will not explode completely if at all.

Natural silicas such as randanite and chemically prepared amorphous silicas have been used as substitutes for kieselguhr but with no greater advantage.

Ordinary black blasting powder was tried as an absorbent in place of kieselguhr and it was found to greatly increase the strength in fact the strength of the mixture was found to be greater than the sum of the strengths of the nitroglycerin and black powder when fired separately.

Black blasting powder was formerly composed of approximately 10 per cent sulfur, 15 per cent charcoal and 75 per cent nitrate of potash. The sulfur which is used to lower the ignition point of black powder has no value as an absorbent of nitroglycerin therefore it was eliminated leaving charcoal and nitrate of potash. Nitrate of soda which is far more abundant and less expensive than nitrate of potash was substituted for the latter because as an oxygen carrier it was equally as efficient. This left the charcoal as an absorbent. Wood pulp or wood meal was found to be a better absorbent of nitroglycerin than charcoal and as it was just as good a combustible, it was substituted for the charcoal. Through this evolution we have the modern so-called "straight" dynamite nitroglycerin wood meal and nitrate of soda. In the United States the first dynamite manufactured was in 1866 in California by the Giant Powder Company.

While these changes produced a stronger and more efficient dynamite than the former "guhr dynamite" yet it did not lower the freezing point which was still a serious handicap for some uses. Modern chemistry was here brought into play and explosive products from nitrated petroleum and coal tar derivatives such as TNT nitrobenzol, picric acid and others were substituted for part of the nitroglycerin ingredient. This tended to lower the freezing point to a degree approximating that at which water freezes. Thus we have the L F or low freezing dynamites. Low freezing dynamites will often stand long initial exposure to temperatures below the freezing point of water and short exposures to temperatures much below this without freezing but when once frozen and thawed they again freeze much more readily.

Further chemical research developed high explosives which did not freeze at any temperature no matter how low.

Chlorate of potash explosives are manufactured to a very limited extent, as their production is extremely dangerous and nearly every company attempting their manufacture has met with a serious explosion sooner or later accompanied by the loss of life. Paradoxical as it may seem these mixtures are called "Safety Explosives." Chlorate of potash which is one of the ingredients in fulminate of mercury detonating caps is so extremely sensitive to heat friction and impact when mixed with other combustibles that its use as a commercial explosive is attended with considerable danger.

On account of the absence of nitroglycerin non freezing explosives do not produce what is known as a "powder headache." This is a characteristic which is second in importance only to their non freezing qualities. While a powder headache is by no means a serious matter it oftentimes produces so much inconvenience among workmen who handle dynamite that non freezing powder is selected solely for its non headache properties. To one extremely susceptible to the effects of nitroglycerin merely shaking hands with a person who has been handling ordinary dynamite will produce a violent headache.

The thawing of dynamite is usually attended with more or less danger owing to the unstable condition of crystallized nitroglycerin when frozen. Investigations have shown that the greatest percentage of accidents from handling explosives is due to thawing methods. In mines, accidents from thawing dynamite have been reduced to a minimum, due to the work of the United States Bureau of Mines in their investigations and recommendations for best thawing methods and also the strict Federal and State supervision and inspection in all phases of the mining industry. But in other operations such as quarrying agriculture, road work,

Using dynamite under conditions where non-freezing characteristics are valuable

contracting and miscellaneous blasting accidents from thawing are quite frequent. The New York Industrial Code for example states in the Rules and Regulations, "No blaster shall attempt to use any dynamite that is frozen" also "Only approved methods of thawing shall be permitted." The "permissible" explosives so called on account of having been tested and approved by the Bureau of Mines for use in gaseous and dusty mines automatically cease to be permissible when they are frozen. In Alaska the law requires that a suitable house in which to thaw explosives shall be built separate from the other mine buildings and shall be equipped with suitable apparatus for thawing explosives.

When the proper thawing methods recommended by the powder manufacturers and the Bureau of Mines are used, the danger is reduced to a minimum but as

ORDINARY dynamite freezes at about 50° Fahrenheit, special low-freezing varieties of this standard explosive remain unfrozen down to about 32 the freezing point of water. Much work is done with explosives in climates where the normal temperature for long periods is far below these limits, and in such climates, the thawing of dynamite is a familiar and very hazardous pre-requisite of its use. This article describes the progress in the development of dynamites which remain unfrozen at all temperatures to which it is humanly possible for the weather to descend — THE EDITOR

carelessness increases the danger also increases by the nth power. At its best thawing is an expensive tedious troublesome time consuming and dangerous operation all of which have been overcome in non freezing high explosives. In extremely cold weather a non freezing powder only should be used. It should also be used in moderately cold weather where thawing conditions are not possible or practical.

Non freezing powders are not as water resistant as straight nitroglycerin dynamites or gelatin dynamites and for that reason should not be used under water. The heavy paraffin paper shell of each cartridge protects the powder from absorbing moisture in damp or wet bore-holes. If conditions of moisture are not too severe the paper shell may be slit to facilitate better packing.

The velocity of detonation, that is, the quickness with which the chemical reaction takes place, ranges from 9500 to 12,400 feet per second. This is quicker than gelatin dynamite but not as quick as straight nitroglycerin dynamite.

The inflammability or ease with which non-freezing powder is ignited and burns ranges about the same as straight nitroglycerin dynamites. It is more inflammable than ammonia or gelatin dynamites.

Non freezing powder is extensively used for quarrying, stripping, mining ore, clay and shale blasting, agricultural blasting blasting ice and for all blasting at very low temperatures. In agricultural work it is not suitable for blasting ditches by the transmitted method. It is particularly adapted to quarry work where well drill holes are used.

The strengths in which non freezing dynamites are regularly manufactured range from 30 to 75 per cent. They are packed in various size cartridges, the standard sizes being 1¼ inches in diameter by 8 inches long and 4 inches and 5 inches in diameter in lengths of 8, 10, 12 14 and 16 inches. In the 1¼ x 8-inch size of cartridge, which is the size generally used, there are between 225 and 250 cartridges per 100 pounds.

London Fogs

THERE is no fundamental difference between mist and fog in most cases fog is only a dense mist, and the density at which mist becomes fog is a matter of definition. When mist and fog are formed in fairly clear air they are white. On the other hand if the air contains a large quantity of impurities, such as carbon particles from imperfect combustion, the mist particles absorb the impurities and become themselves dark-colored. In this way are formed those dense fogs in London which are likened to pea soup. It was originally thought that the density of a London fog was due to the fact that the smoke of the city provided an unusually large number of nuclei on which condensation could take place thus offering a temptation to the air to deposit its moisture which it could not resist. As a matter of fact there are always sufficient nuclei in the purest air in England to allow of the formation of fog whenever the meteorological conditions are suitable.

The relationship between smoke and fog is peculiar, and may be said to be accidental. The meteorological conditions which are necessary for the formation of fog are such that while they last smoke cannot get away either vertically or horizontally from the place of its origin. Above the fog there is a temperature inversion which effectively prevents all upward motion of either air or smoke, while fogs over the land usually form in calm air. Thus during a fog practically all the smoke which London makes is kept over it and remains within a few hundred feet of the ground.

This smoke combined with the deposited water can as we all know, produce such an obscurity that midday is as dark as midnight. The total abolition of smoke from London would not reduce the occasions on which mist and fog occur but many fogs would remain mists, and we should never have a "London particular." For the formation of mist and fog it is necessary that the temperature of the air should continue to fall after the dew point of the air has been reached.

The extent to which the temperature continues to fall below the original dew point determines the density of the obscurity, neglecting for the moment the effect of impurities. This cooling can be brought about in several ways of which only two are of real importance in this connection.

Fogs may be caused by warm air blowing over a cold sea or a cold land surface. The fogs of London are, however, almost entirely due to the loss of heat from the lower layers of the atmosphere into a clear sky above. The air radiates its heat, its temperature falls and condensation takes place as already described. Other methods of fog formation, such as the mixing of warm and cold air, are of secondary importance and never give rise to more than patchy local mists or light fogs.—*Abstract from Nature*, April 14, 1923.

Exit the Pullman Car Hammock

THE fishnet hammock, subject of an old joke which the writer will forego, is destined to disappear. It provided a place for the clothing but assured the clothing of an early trip to the presser, for nothing under the sun could have been more efficient in the work of putting wrinkles in the wrong place than this so-called convenience with which the American people have put up for decades. The Pullman Company is now equipping its new cars with a rack designed to occupy the same position above the berth as did the hammock, but having the advantages of holding the trousers flat and of providing a place for the hand baggage. This new rack is made in skeleton form of one-inch green belting and is fastened to either end of the berth by means of hooks. These hooks slide on iron brackets so that the whole rack folds back flat either when it is not desired by the passenger or when the berth is made up for the day. This rack will be appreciated by travelers who have wished to retain hand baggage in their berths but who have found it necessary to find a place for it to lie where they prefer to be lying themselves.

New Pullman car clothing rack which provides a place for luggage and permits the clothing to be laid out flat

Stage Scenery on the Building Block Principle

ALTHOUGH it was generally believed that the limit of novelty in stage setting and scenery had been reached, such has recently been proved not to be the case, for the third production at the Earl Carroll Theatre in New York City has witnessed the introduction by Mr. Carroll of an original and simplified method of building up scenes that bids fair to be of great usefulness, especially on rather small stages.

Heretofore, when raised platforms and steps were required, these were specially built. They invariably occupied a great deal of space and could only be used on an extended scale in such places as the New York Hippodrome, where there was ample room to store them when not in use. Some of the most effective scenes at this giant playhouse were obtained by long and wide flights of stairs down which row upon row of girls marched out of sight beneath the waters of the tank.

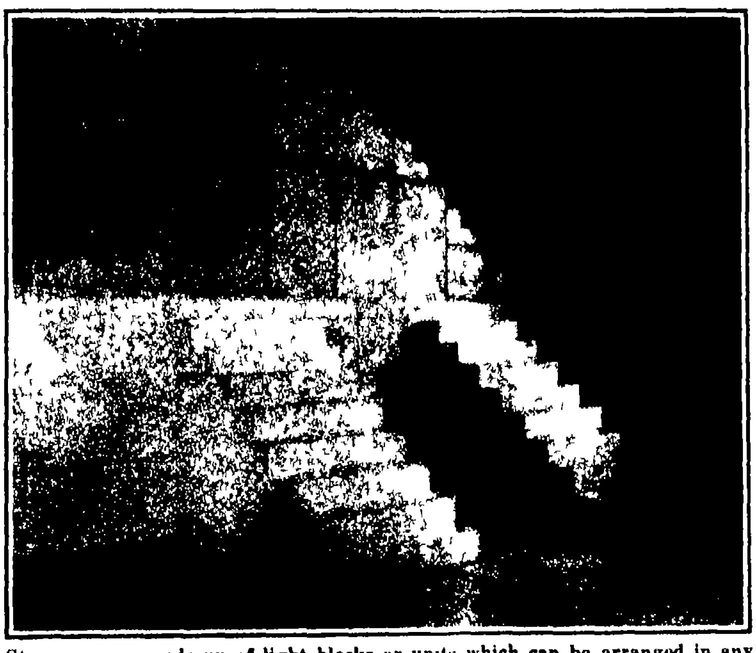
In producing his latest offering Mr. Earl Carroll determined to make use of these staircase effects if possible. Heretofore staircases had been built up in two sections and separated for storage, while platforms were elaborate affairs (sections of the stage) that required hydraulic elevators to raise them into place. Needless to say, the expense and cumbersomeness would preclude their use in a small theatre, the latter particularly in a revue with many scenes. To get around the difficulty, Mr. Carroll invented a system of unit building block construction whereby he could build a long wide flight of stairs in a limited space as well as any number of raised platforms of any shapes which might be desired.

After working out his problem on a small scale with a tiny model Mr. Carroll proceeded to construct the actual settings for the stage of his theater. In doing this he followed the model precisely to scale.

As will be noted in the accompanying view, large units are shown horizontally with stairs leading up to them and with other stairs leading up from each side to the apex. These stairs are all constructed in units of two steps each, assembled upon different sized blocks whose corners form intermediate steps. Any scene whatsoever can be quickly and easily built up by but four stage hands since the different sized units consist of light frames covered with three-ply veneer. For transportation purposes all units except the smallest can be knocked down flat, while these non-collapsible two-step units can be placed in interlocked arrangement forming a block. In order to get a long flight of steps in the limited space of about thirty feet, the steps were made with but a ten-inch tread. This is not exactly a sumptuous stair, but is sufficient for all purposes.

The tread and height of the steps play an important part in obtaining the proper lighting effects. In the present instance much thought has been put upon securing the lighting that will properly display the figures and costumes. On each side of a secondary proscenium is a vertical row of spotlights while colored and white lights in the flies and in the "canopy" in front of the stage as well as below the balcony railing (called "face lights") properly light the actors and do away with shadows. There are also the usual spot lights in the cinematograph booth at the rear of the balcony. All these lights must be carefully calculated to meet the stair dimensions.

Mr. Earl Carroll's unit block system of ground stage scenery construction or setting is adapted to many forms of scenery, as the blocks may be covered or masked with painted scenery wherever desired. The blocks are all painted a light blue and sprayed with silver. Italian blue was found by experiment to be the proper color to tint the back wall of the theater which represents the sky and forms a suitable background for any scene. The invention is a decidedly novel and useful one.



Stage scenery made up of light blocks or units which can be arranged in any desired manner and knocked down for storage and transportation

Recent Aeronautic Investigations

FEW industries offer better illustrations than the manufacture of airplanes of the intimate relation between purely scientific investigations and the practical application of the results. As an example of this fact attention may be directed to three experimental researches in progress at the laboratories and flying station of the National Advisory Committee for Aeronautics at Langley Field, Virginia.

The first research deals with the pressure distribution over the wings, tail surfaces, etc., of an airplane. What is novel in the present investigation is the extension of the problem to airplanes making maneuvers, and to wings of different plan form varying the angle of attack and the aileron angle. The method adopted is simple: numerous series of small openings are made in the surface to be investigated; each of these is joined by a rubber tube to a capsule containing a metal diaphragm, to which is attached a tilting mirror; a beam of light is reflected from this on to a photographic film which may be shifted, thus permitting a series of observations to be made. The apparatus in use records the pressures existing at 60 points simultaneously.

Among the questions already investigated are the change in pressure distribution produced by a loop, a roll, etc.; the effect of the shape of the wing tip (square corners, elliptical, raked off, etc.); the influence of the air stream from the propeller. From the knowledge thus obtained the airplane engineer can decide upon the best shape of wing or elevator, etc., and upon the relative strength required in a different part of his structure.

The second research was undertaken to learn the actual motion of an airplane in alighting, taking off, making oscillations and maneuvering, and at the same time to record the motions of the control surfaces and the forces exerted by the pilot. A large number of instruments is required, all of which were newly designed with special reference to lightness and compactness as well as to accuracy. The central instrument is a photographic film wrapped on a cylinder which is in rotation, for all records are made upon this by beams of light reflected from mirrors which form part of all the various instruments. When in actual use on an airplane the pilot simply presses one button at the beginning of a maneuver and this starts everything. The instruments in use at the present time are as follows: (a) chronometer, (b) airspeed recorder, (c) single component accelerometer, (d) three-component accelerometer, a combination of three of the previous instruments, (e) angular velocity recorder making use of a high speed electric motor as a gyroscope, (f) three-component angular velocity recorder, a combination of three of the previous instruments, (g) control position recorder, (h) force recorder.

From a practical point of view these instruments allow the performance of an airplane to be recorded accurately in a manner quite free from the personal impressions of the test pilots, and further the records taken in any maneuver tell a story which is perfectly plain.

Einstein and the Recent Eclipse

A WRITER in Nature for April 21 says that the two sets of results of the expeditions, one from Canada and the other from the Lick Observatory to Wallal, Western Australia, for the solar eclipse of last September have now come to hand and that both report in favor of the Einstein shift of starlight. In each case the number of stars measured was very large—exceeding 80, the magnitudes being between the seventh and the tenth. From this it is evident that the exposures were comparatively long and that consequently there would be considerable extension of the corona on the plates which would obliterate the stars nearest the sun. The measures, however, were sufficiently exact to give a decisive result using the more distant stars. Professors Campbell and Trumpler measured all their plates in duplicate; the values for the shift at the limb of the sun deduced from the individual plates ranged from 1.59 inches to 1.86 inches, the mean of all being 1.74 inches, which is only 0.01 inch less than Einstein's predicted value.

As Professor Campbell is well known to have been in no sense predisposed in favor of Einstein's theory, this result combined with that of Professor Chant and the mean of the Principal and Sobral results in the 1919 eclipse will probably be regarded as setting the question at rest.

One Law Versus Forty-Eight

The Practicability and the Necessity of Uniform Motor-Vehicle Legislation in All the States

By the SCIENTIFIC AMERICAN *Staff*

LAST month we carried the opening article of a series upon the legal and physical problems created by the growth of the automobile to its present place in the national life and the national consciousness We gave an analysis the burden of which was to show that the most immediate attention requires to be given the problem of making the motorist acquainted with the laws of his own state, and of the states through which he drives This month we try to show that, so long as they remain in their present diverse and ill-digested condition, it is not going to be possible to do this effectively, and that therefore the necessary relief is to be found only in the direction of standardizing the laws of the individual states around a single formula applicable in all states With the next article in the March or another early number, we shall pass from destructive to constructive criticism, suggesting some of the means whereby uniformity may be attained, and some of the provisions which a uniform motor code proposed for adoption by all states should have —THE EDITOR

WHEN one enters Connecticut over any major highway, one meets a sign board that may not be quite as big as the proverbial house but that looks much bigger when first it bursts upon the eye 'You are entering Connecticut,' says the sign, and it proceeds to catalog the major points of the Nutmeg State traffic law Speed limits regulations for passing trolleys the sort of locality that defines the zones in which slower speed is exacted—all important points on which Connecticut rules do or may differ from those of other States, are here epitomized for the benefit of visiting and home coming motorists Other States employ the same idea, we mention Connecticut merely because it is the most familiar example of those which we might cite

Pennsylvania practice typifies another way in which it is possible to aid drivers from across the State line in their contact with the law, while at the same time making it vastly easier for home motorists to conduct themselves according to the proprieties In this State there is but one lower speed limit—fifteen miles per hour It applies in all cities towns, villages and cross-roads aggregations of houses, regardless of whether the place be incorporated or whether the houses average 90 or 101 feet apart It applies equally at points on the open road made dangerous by rail or road crossings curves grades etc Wherever it applies, the law instructs the State Highway Commission to erect signs plainly warning the motorist of the restriction, and where the restricted zone runs through a village or for any other reason is of considerable length, the law is equally mandatory that its termination as well as its beginning is indicated One who drives in Pennsylvania comes to know and to watch for the welcome 'End of Limit' sign which leaves him free from all doubt as to just where it is proper to resume speed

Pennsylvania's procedure is ideal in more ways than one Not alone is one advised of the location of restricted zones, and enabled to know with a minimum of effort what the restrictions are one is beyond this assured that in the absence of these signs the State code applies Local regulations conflicting with the State laws are explicitly barred and the presence of the local rules in the State code makes this prohibition effective But not everywhere is it thus Of the 40 States for which information is on hand as we write no less than 21 permit—sometimes in so many words and sometimes through failure to prohibit it—the setting up by local jurisdiction of speed limits and other traffic laws without reference to the degree of contradiction which may exist between these and the State-wide code Nor is it by any means the case that all such States require locally restricted areas to be posted

Now of course we have with us always the good old Anglo-Saxon common law so that if you go into a strange State and set up ignorance of the statute as an excuse for its violation, the magistrate may very properly tell you that he isn't interested in your ignorance of the law But as indicated in the previous article of this series and by the very practices cited in the cases of Connecticut and Pennsylvania we are today going through a process of quiet unwritten modification of this principle of law, which places upon the agencies of Government some degree of responsibility for broadcasting the provisions of our more complex enactments This is the more so when as with most of the traffic laws the statute defines not crime as against innocence but conventional behavior as against mere unconventional acts which are not in themselves criminal So if you plead ignorance of the traffic law even in your home State the magistrate is not likely to tell you that you are chargeable willy nilly with knowledge thereof What he is very likely to tell you however is that the State has gone to considerable expense to print in convenient booklet form, all its laws governing motor vehicles that this booklet has been available for your examination without cost or inconvenience to you and that under these circumstances you are alone responsible for your own ignorance Strictly speaking of course, this is true But a careful study of the little books in which the various States have put up their traffic laws for the use of the consumer leaves us quite cold over the practical possibilities of learning to drive legally and conventionally therefrom

All these codes necessarily contain a lot of matter about licenses for home cars and home drivers This section is of interest to the man who is buying or selling a car, and to the visitor who contemplates so long a stay that he may subject himself to the necessity of registering his car, himself, or both But it has no bearing whatever upon the more urgent question of how to drive legally and safely

What are the speed limits? Where do the lower limits apply? Does one give the right-of way to the car on one's right, or does the State fail to prescribe a rule here? Does the car on the main road specifically have the right-of way over one emerging from a private way, or does the State again leave this to the drivers to settle anew on each encounter? How shall one behave in the presence of a standing trolley? Are the headlights which you brought with you legal in this State? Will you be required to add a mirror, or some other article of equipment which is not demanded by your own State? Is the visibility of your rear license plate up to the mark, or must you purchase a new tail light assembly? May you if the weather calls for them mount tire chains once for all or must you remove them when you come to a cleared paved road? Shall you dim for approaching traffic or will this be regarded as admission that your bright lights are too bright or will it be taken as driving without adequate light, or will your very ability to dim and brighten your lamps from the driver's seat be in itself a violation?

These and numerous other points will come specifically into the mind of every conscientious motorist every time he crosses a State line Many of them will even bother the home driver to some extent so that he must check up on them from time to time In this situation, given physical possession of the official booklet of motor laws to start with, the next thought in any rational mind is of an index

Well of 40 motor law pamphlets and booklets from 40 States, 20 have indices. Three others have running heads throughout the text, on a basis that makes them of material aid to the eye that is searching for the speed limit or the reciprocity period The remaining 17 lack any pretense at index or other guide Of these, one contains more than 16 000 words according to our rather practiced calculation and numerous others run above 10 000 Is it rational to ask the man who wants to know whether he may pass a standing street car to read through the equivalent of five to eight solid pages of the SCIENTIFIC AMERICAN in search of the information? We might answer with a categorical negative but we will not be even so rash as this We will say only that it depends upon the character of the text in question

Some States have well modified motor codes. Others —to put it mildly—haven't There is every reason why the latter rather than the former should be the case Sometimes the motor code consists of a series of isolated acts passed from time to time when a gap in the existing laws became evident When this is the case these acts are usually arranged in chronological order of passage in the little booklet prepared for the public convenience Indeed, how else can they be presented?

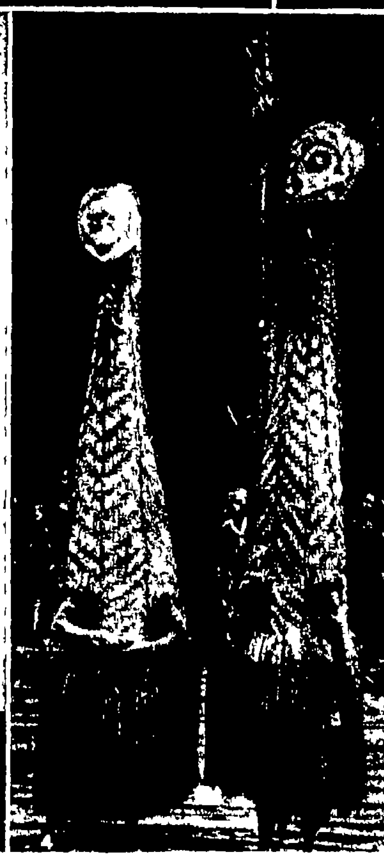
Other States, some ten years ago more or less, passed a general traffic act, designed to be a complete and self-contained whole. Maybe it was and maybe it wasn't, at the time, in either event, it is perfectly certain that it wasn't, now Increasing traffic, changing conditions, changing outlook upon the questions of policy involved in automobile licensing and traffic regulation, have all forced frequent amendments and additions—the one idea that runs through the series being simply to keep the code up to date The earlier and the simpler amendments can be, and often are, actually applied to the original text by the compositor, the wording of the law being changed as provided by the amendment, or the new clause being inserted at the point where it claims to belong. But usually the later amendments post date the pamphlet itself, and are carried on pages inserted in the back, or even in separate leaflets Moreover in numerous cases the "amendment" is really a lengthy added section, of large and miscellaneous import, which at best can only be grafted on to the original act, at a point where its connection is not particularly obvious, and which at worst is published in a separate leaflet, with nothing in the original pamphlet to indicate that the act as there printed has been enlarged Usually such a large modification of the traffic act as is contemplated by these remarks is given a separate legislative title as Chapter Umpty Ump of the laws of Nineteen Blankety Blank, and it is then printed as such with no attempt whatever to correlate it with the related matter in the original law

The result of all this is to make the printed pamphlet practically unusable in the absence of an index. This throws or should throw something like half the States out of court on the claim that they have put their traffic codes in the hands of the public For we do not exaggerate when we say that in most of the unindexed pamphlets (and some of the indexed ones for that matter), the only way to find a given item be it speed laws, headlight provisions or what you will is to read the text until you come to it Even in doing this, there is a large hazard It is a conscientious reader indeed who will take in every word, and not assume, after having read the opening portions of a paragraph on, say the permissible weight of motor trucks that it doesn't contain what he is looking for In more than one instance we searched quite honestly, but using this technique, for a specific item without success only to run on it later in looking for something else Driver's age-limits and reciprocity periods seem peculiarly prone to getting tucked away as a subsidiary clause of some section having no apparent connection with these points.

One or two crowning bits of stupidity demand special mention Pennsylvania as we have implied, is a model State in its motor administration and its codified laws are admirably arranged—with no index, but with a very complete and effective series of running heads located in the extremely wide side-margins This pamphlet lacks a title page, the text beginning right on what would be the front cover In the brief title at the head of this page one fails to find the name of the State One scans the preamble, the enacting clauses, etc with the certainty that somewhere there must be reference to the legislature of the sovereign State of So-and So But no, so one turns to the last page—and again one is fooled There is the Governor's signature, in facsimile, large as life, but even under it there is no line indicating of what State he is chief executive? It is a solemn and sacred fact that in this entire book, from first word to last, the name "Pennsylvania" does not once occur The Act does not even carry a date-line from Harrisburg as an indirect clue. If you didn't know to what State Mr Gifford Pinchot pertains, or if he chanced to have a trick signature that nobody could read, it would not be possible to identify this law as that of Pennsylvania

New Jersey has a marvelous Commissioner, so good that he has survived numerous changes of administra-

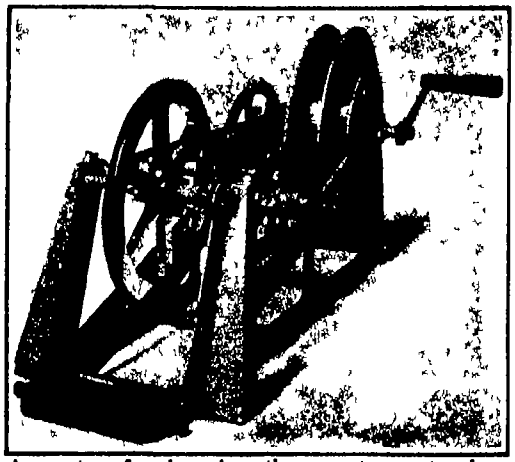
(*Continued on page 140*)



A RACE of head hunters with Jewish features has been discovered by Captain Frank Hurley, explorer, 250 miles up the Fly River, at Lake Murray in the large island of Papua. The new race was discovered last February and called "Sambios," because of their habit of calling out "Sambio" and waving their paddles in friendly fashion on approach. This deception almost cost the lives of the explorer and the white men with him. They were lured into an ambush by the tribesmen on their first visit ashore, but escaped in a hail of poison arrows. Friendly relations were finally established by trading tin boxes and other empty metal containers for native products. The Sambios had never seen metal before and did all of their boiling in stone or bamboo, so that they ultimately accepted the explorers' friendship as of more lasting value than their heads.

Our views, taken from Captain Hurley's collection are as follows: (1) The Motuan village of Hanuabada which is built out in the water, off a small island. Doubtless the Motuans built their homes in this fashion to render them impregnable to attack from hostile land tribes. (2) At the remote end of the great Kau Ravi, which is shown in another view (3) are these grotesque objects called Kopiravi. These were held in great dread excepting by the ancient chiefs who were high priests. These objects, symbolizing crocodiles were regarded as gods. Victims were placed in these Kopiravi after having their arms and legs broken to prevent escape. The body the next morning was cut up and seasoned with coconut for boiling. (3) Entrance to the great Kau Ravi. This large structure functions as a parliament house, cathedral, museum and club house. It is 75 feet high and 400 feet long. Only the warriors are permitted to enter and death is the penalty for female transgressors. The interior is divided into dens in which are shrines containing the skulls of victims that have been killed and eaten. (4) The taboo goblins of Urma. The taboo goblins are regarded as sacred spirits. (5) Main street of Mailu village, southeast Papua. These remarkable people are a maritime race, carrying on their trading by sea. Their canoes are seafaring craft capable of carrying up to fifteen tons. (Photos Copyright, Captain Frank Hurley.)

SNAPSHOTS OF THE "SAMBIO" HEAD HUNTERS OF NEW GUINEA



Apparatus for lowering thermometers into deep wells

The Heat of the Earth

Apparatus with Which Deep Temperatures Are Determined

By Otto Wilson

IN THESE troubled times it takes a startling eruption of a Mt Etna or a disastrous earthquake to remind us that we are living in a world unfinished physically as well as politically What the swarming humans on the earth's surface would see if they could gaze a little way beneath their feet would give many of them a thrilling moment of surprise We ordinarily carry around with us the idea that the earth is a great solid globe probably rather hot in the interior But if we should picture to ourselves a steel cannon ball heated in an intense flame until it was far more than white hot and then sent whirling on its way covered only with the thinnest of thin films of chalky dust we should probably have a much more accurate idea of what sort of home we inhabit It is generally accepted that the earth's interior has a density as great as or greater than that of steel and a temperature which would not only melt but even vaporize most metallic elements there if it were not for the immense pressure which keeps them in solid form The outside lithosphere or shell of rock is itself burning hot except at the very surface and men have already penetrated to depths where the heat is almost that of boiling water

Geothermic studies have been carried on in a more or less haphazard fashion for a good many years and a good deal of data has been accumulated But it is only since the miners have eaten their way far down into the surface rocks and the oil seekers have sent their drills still deeper that the problem of determining the earth's heat has become of practical as well as scientific interest The Federal and State geologists have been busy in recent years in making observations and gathering data and three years ago the U S Geological Survey published the first comprehensive account of geothermal conditions that has yet appeared This survey includes for the most part the observations of geologists made in mines and wells, but many of the figures are admittedly of questionable significance as they were obtained from temperature-observations of flows of water whose depth of origin could not always be determined A careful rechecking of all these data and the gathering of many new records not only for the United States but for all the rest of the world as well by Mr C E Van Orstrand of the U S Geological Survey is now in progress

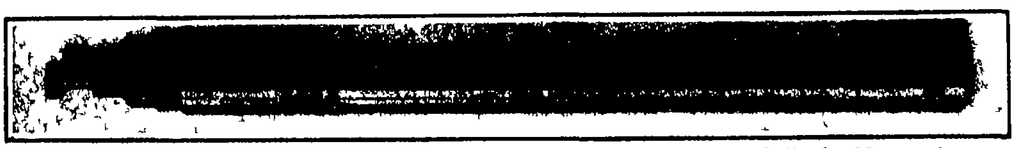
One fact is conclusively shown by these studies and that is that the rate at which the temperature of the earth's crust increases with increasing depth varies widely for different parts of the earth Some of these variations are obviously due to local causes In the upper peninsula of Michigan near the cold waters of Lake Superior the deep copper mines of three to five thousand feet show temperatures at the bottom ranging from about 60 to 90 degrees Fahrenheit as compared with a mean annual surface temperature of 44 degrees This is a rate of increase in general of one degree in 120 to 140 feet or more whereas in central or southern Michigan the rate is one degree for differences in depth ranging from 40 to 90 feet In a broad belt of territory in the West which includes western Washington Montana South Dakota and Nebraska the general region in which the hot springs and geysers are found the earth becomes rapidly hotter with increasing depth For the last two-named States the rate is about one degree Fahrenheit for each 20 to 40 feet of increased depth and in Idaho, in regions of recent volcanic activity observations of temperatures in wells have shown a rapid increase of about one degree for 10 to 20 feet These local variations make it difficult to arrive at generalizations on the subject of the average rate of increase in temperature as we go deeper into the earth's crust but it seems to be fairly well established that the rate is considerably less in the older rocks than in the newer formations

The deepest hole which men have ever made in the earth was in West Virginia where the Hope Natural Gas Company, under the direction of its vice-president Mr John B Corrin of Pittsburgh set out to explore the lower strata in a search for deeper oil and gas sands than any that had yet been reached in the State They sent their drill down to a depth of 7579 feet, or just 341 feet short of a mile and a half when a cave-in effectually stopped further operations While they did not reach their objective the venture bore much fruit of scientific interest in the shape of minute fossils and temperature readings. Mr Van Orstrand equipped with specially devised thermometers, made regular temperature tests every 100 feet down to 2000 feet and every 250 feet thereafter, which he found to agree in the main with the records which he had previously taken in the world's second deepest well drilled by the same company in West Virginia in 1916-18. At a depth of 7500 feet where the last temperature test was made the thermometer registered 168.6 degrees Fahrenheit as compared with 53.3 degrees the mean temperature at the surface This is an average of 65 feet for each degree in increased temperature for the whole well although the gain was not uniform all the way down The rate in the second deepest well was about 70 feet and others in West Virginia showed much the same temperature increase although in some of them as much as 80 or 90 feet of added depth was required to raise the temperature one degree The following figures show how hot were the rocks at various levels and how steadily the temperature rose

Depth	Deg F	Depth	Deg F
100 feet	53.7	4000 feet	104.7
500 feet	59.9	4500 feet	111.6
1000 feet	65.6	5000 feet	121.1
1500 feet	71.8	5500 feet	133.1
2000 feet	78.4	6000 feet	143.0
2500 feet	86.0	6500 feet	154.5
3000 feet	91.9	7000 feet	162.2
3500 feet	97.6	7500 feet	168.6

It is not altogether a simple matter to get these temperatures accurately when the depth reaches several thousand feet Several different kinds of thermometers have been used but for depths down to 3000 feet Mr Van Orstrand has found that the electrical resistance thermometer is best for use in wells which are free from oil or water For lowering this thermometer into the

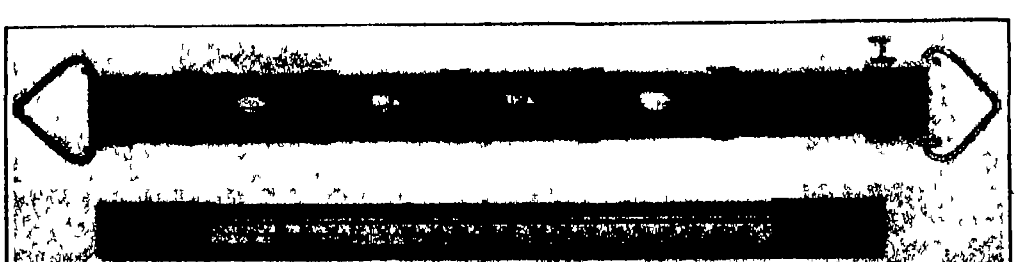
(*Continued on page 143*)



Steel tube for thermometer in wells where water is present If the mercury bulb should come in contact with the water, the pressure would drive the fluid upward and the readings would be of no value

In the center is a plain brass rod The wires keep it from swinging against the sides of the hole which would disturb the mercury in the thermometers immediately above The aluminum disks aid the operator to determine when the line has struck water

Weight attached to the end of the line used in lowering thermometers into deep wells



Maximum-recording mercury thermometer used for measuring deep-well temperatures, with the tube in which it is placed

The inconspicuous opening of the world's deepest well, with a thermometer waiting to be lowered in

Flivvers of the Air That Approach 100 Miles Per Gallon

THE recent competition for small motor-driven gliders or light airplanes at Lympne resulted in some wonderful performances and definitely marks a new trend of design which must ultimately produce a type of aircraft which in its relation to ordinary aircraft will be analogous to the position of the cyclecar in the automobile world. The conditions of the competition limited the size of engine used to 750 c.c. capacity roughly equivalent to six horsepower, the chief prize being awarded to the machine accomplishing the greatest distance on one gallon of any standard fuel. Subsidiary prizes were awarded for speed, altitude and for greatest distance flown irrespective of fuel consumption. Although the possibility of flying with engines of very low power has been recognized for some considerable time, and especially so since the progress achieved in the design and use of gliders, there has always existed an impression that machines of this class would be extremely fair weather craft, demanding more rather than less skill in piloting. The outstanding feature of the Lympne competition was the excellent behavior of most of the machines in extremely bad weather, which gave no indication of lack of power or control. The course was 12½ miles in length and roughly triangular in shape, the latter circumstance definitely precluding the possibility of any assistance being rendered by favorable winds. Further the term motor glider which has been generally applied has suggested that the flights of the machines would be in the nature of motor-assisted glides in which soaring against the rising current would play an important part. When it is considered however, that the absence of any means of restarting after the engine had stopped in the air would necessitate its being kept running during the period of soaring which would necessarily be at a slow rate of forward speed, it will be seen that this maneuver would detract from rather than add to the miles per gallon flown. Actually the machines flown at Lympne as will be seen by the accompanying illustrations were miniature airplanes possessing a remarkably high performance and which moreover was not obtained at the expense of structural strength, most of the machines conforming to the regulations regarding factors of safety, etc. The machines accomplishing the greatest distance per gallon of fuel were the Wren and "A. N. E. C." monoplanes which tied with the excellent figure of 87.5 miles per gallon. The former is a cantilever monoplane with the landing wheels partly enclosed in the body, the power plant being a diminutive motorcycle engine of three horsepower driving an airscrew three feet six inches in diameter direct. It possesses a top speed of about 55 miles per hour, and was flown during the competition in very rough weather. It was computed that on a fairly calm day this plane would fly for 110 miles on one gallon of fuel. The "A. N. E. C." monoplane with a six-horsepower engine gave a really astonishing performance. Apart from its low fuel consumption, its top speed was in the neighborhood of 80 miles per hour and its best climb during the week was 14,400 feet in a little over the hour. Its ceiling, i. e., the maximum altitude possible was considered to be about 20,000 feet. This with an engine of 750 c.c. capacity. The high efficiency shown must in this case be attributed to the wing section used, this being computed to possess a lift-to-drag ratio of 22 to 1. This in other words means that the resistance of the wing in flight is only one-twenty-second of the weight lifted. Unfortunately the addition of a body reduces the lift-to-drag ratio of the complete machine to an extent dependent on the degree of streamline effect obtained. Thus it is quite possible that although the wing alone may possess a high L/D ratio that of the complete machine due to a badly shaped body may be quite indifferent. In the case of the A. N. E. C. monoplane the L/D of the complete machine is stated to be 16 to 1. Therefore, as its weight loaded with pilot is 465 pounds the thrust necessary to maintain horizontal flight at the speed at which this L/D occurs, is 1/16th of 465 = 29 pounds. It will thus be seen that as the resistance of a machine is reduced the reserve power available is increased. This reduction of resistance may be obtained by very careful detail design in which there is a minimum of exposed wires, fittings, etc., or by the production of improved wing forms. The latter point indicates a direction in which these light planes will be of immense value in enabling experimental wings and the effect of various controlling arrangements to be tried out in flight at low cost affording an invaluable check on wind tunnel model experiments.


A. N. E. C. monoplane with six horsepower engine, which flew 87.5 miles on a gallon of fuel, won the altitude prize with 14,400 feet, and came second in the speed contest with a mark of 74 miles per hour


The Wren monoplane which shared the laurels with the A. N. E. C.


The De Haviland six horsepower monoplane driven by Capt. Broad

The Parnall Pixie which won the speed contest had a top speed of about 90 miles per hour, two laps having been flown at a speed of 82 miles per hour. Only one machine, the Gnosspelius Gull, departed from the tractor airscrew arrangement. In this machine the engine was mounted on the wing immediately aft of the pilot, driving the twin propellers by means of chains.

The controllability of the machines generally was excellent, this being instanced by the fact that two were looped during the meeting. In this connection it was obvious that valuable lessons had been learned from the results of the gliding competition at Itford last year.

It is also apparent that with careful design, particularly in the reduction of resistance, it will be possible to construct a two-seater machine with an engine of six horsepower which will possess a top speed of about 70 miles per hour, a landing speed of 25 miles per hour and which can be housed in a space no greater than that afforded by the average private garage. These machines possess the very valuable attribute of a low landing speed which at once reduces one of the chief risks of flying, and further permits landings to be made in small spaces. It must be admitted however that considerable progress in stability and control must still be made before these machines can come into anything like general use. This of course is a matter of time. For the immediate present these machines have a very great value for the preliminary training of pilots and for economical full scale experimental work. To a lesser extent they will also be available as private touring machines and for sporting purposes.


The Avro biplane, with 3½-horsepower engine, which reached a height of 13,850 feet

Lichens—Impossible Plants

AMONG the most singular and inexplicable of organisms are those known to botanists as lichens. A lichen is not an organism or species in the same sense that we use the word in referring to other plants or animals. A coconut crab or the tree on whose fruit it feeds, an apple tree or an ant crawling on its trunk, each is a distinct species, a definite entity of more or less homogeneous structure with organs and tissues of a common primary origin and a definite common specific heredity. Each of the examples cited is the product of the union of a sperm and an egg cell from like parents and can come into being in no other way.

It is true that some animals and many plants propagate wholly or in some part parthenogenetically, that is without the fertilization of the egg, and that others increase in numbers through some form of somatic or cell division. But no matter what the exact method it is impossible to have a coconut crab whose parents were anything but coconut crabs or to get a cross between a fern and a flowering plant, a liverwort and a moss, a shark and a sardine, a bat and a bird, or even between two distinct mammals like a cat and a dog.

Yet when we examine lichens we find an entirely different state of affairs. A lichen is composed of two entirely unlike organisms belonging to two entirely distinct and altogether different groups of plants. Biologically a lichen is therefore composed of and is the resultant of the interaction of two distinct and utterly unlike living organisms which go to make up its body. If we section a lichen and examine its anatomy we find it to be made up of a fungus and an alga. The form and texture of most lichens is due to the fungus filaments often being compacted at the surface to form a thick strong cortex, while from the lower surface they extend as rhizoids or otherwise simulate roots.

The alga on the other hand is in nearly every case distributed in a layer within the body of the lichen but much nearer the upper or outer surface so that in section it forms a streak of bright green enmeshed in the white threads of the fungus. The fungus of a lichen however has the new duty of enveloping and protecting the alga so that the latter may increase in number and perform more effectively the task of manufacturing food for the fungus. A result of this is perhaps the reason for the development of the greatly varied and complex bodies of the higher lichens. The fungus supplies the alga with water and mineral salts and may also carry more or less of its carbon supply with it. The alga is protected in such a way that it is able to grow where it would be impossible to do so alone and its continued existence, through cell division is assured.

It is this strange association of two unlike organisms, a fungus as master living as a parasite or a saprophyte upon an enslaved alga, which gives rise to the anomalous organisms called lichens, plants which differ markedly from either of their components.—*Abstract from the Scientific Monthly for February 1923. Article by A. W. Herre, Philippine Bureau of Science.*

Lessons of the Japanese Earthquake

Types of Construction which Survived and Recommendations for Reconstruction

A Resumé of Engineering Opinion

STEEL and reinforced concrete were the structural victors of the Japanese disaster. This in sum, is the opinion of an engineer employed by one of the largest American construction companies to make a study of the industrial buildings which had been erected by this company prior to the great earthquake which made a shambles of Tokyo and Yokohama.

In company with a Japanese architect this American engineer made a very careful and thorough examination of a number of structures which remained standing, although in a somewhat damaged condition. The most striking discovery was that practically none of the great steel columns used in these buildings was permanently distorted. That these members had been subjected to violent flexions was at once obvious, for the masonry piers which had enclosed them were very badly shattered proving the lateral movement of the columns themselves. Especially was this phenomenon noticeable in the second and third stories of the buildings while the first and fourth had suffered relatively less.

These facts indicate very patently that the steel used was both strong enough to withstand the normal dead load plus the live load superimposed by the earthquake movements and that it had an elastic limit high enough to insure its full return to original position after an amount of lateral swaying which was at least sufficient to swing electric light globes suspended on two-foot cords against the ceilings and fracture them.

That steel brick and concrete are no positive insurance against destruction by earthquake shock unless properly designed and unless of good quality is shown by the severe damage that was received by a large six story steel brick concrete building of Japanese construction which was so badly damaged that it must be demolished. In this case the steel was left by the earthquake with permanent distortions. Another similar example is that of a reinforced concrete building built by the Japanese, which collapsed and killed 130 occupants. The wreck of this structure is thought to have been entirely owing to faulty construction. Even allowing for such workmanship and design steel and concrete did not come out with a wholly perfect score. It is doubtful if anything short of canvas tents would. Nevertheless its record is so good and so much better than anything else that there is little doubt that it will be very largely used in the reconstruction which the Japanese are planning and which they are approaching in a truly scientific manner in an attempt to avoid making the same errors again.

Even horizontal reinforced-concrete floor slabs remained intact or nearly so. At the points where bays or sections of the parts of each building joined there were some minor cracks in the floor construction, but these were points where the several sections of the building vibrated independently of each other setting up shearing stresses that were too severe for even the strongest materials to withstand. It would appear that some damage was received by interior walls made of gravel reinforced concrete, but these are not serious enough to preclude repair of the buildings.

Masonry piers suffered quite badly, especially on the middle floors of low four story buildings.

Practically all kinds of facing material failed. Tiles were the most resistant of materials of this class to damage and dislodgement. Next in the order of resistance comes stucco, followed by granite, cut stone and terra cotta. Interior partitions made of hollow tiles were utterly unable to withstand the crushing stresses caused by the lateral movement of the columns, and they fell in fragments. But partitions made of plaster on metal lath were not nearly so severely damaged. Still better behavior was given by partitions of concrete while those of reinforced concrete fared best of all. Even in this material, however, there were some cases of shattering resulting from horizontal shearing, and this was most evident in the case of partitions made of slag concrete.

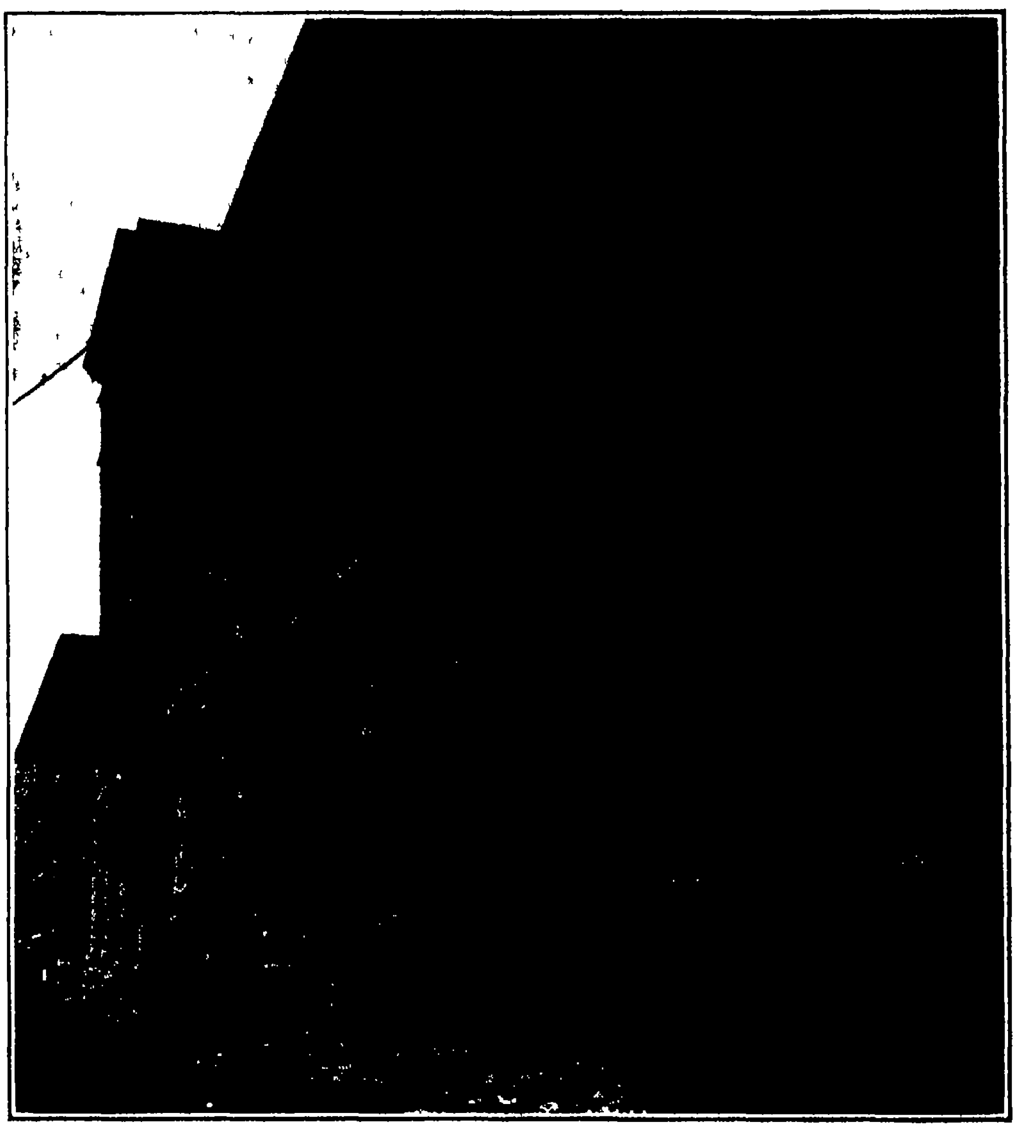
Thus it is evident, judging from the experience of one large engineering construction firm, that steel and reinforced concrete are the materials best suited for construction in earthquake zones, provided that steel of proper strength and high enough elastic limit to return to its original position, is specified and used, and provided that concrete made of carefully chosen materials properly mixed and carefully reinforced, is employed.

As a result of these observations a number of interesting recommendations were submitted by the engineer on the ground. If Tokyo and Yokohama are rebuilt—and, of course, they will be rebuilt, for the Japanese certainly are not the sort of a people that will waste time in lamentation before setting to work to put their shambles in order—it is believed that all foundations should be of piles capped with reinforced concrete, or of isolated pier spread footings, or of solid concrete mats without piles. These piles are in no case to be driven to hard pan or to "refusal." In this manner full advantage is to be taken of the natural cushioning resilience of the earth. For if the piles were driven to rock the full severity of the earthquake shocks would, in the event of another earthquake (an event that is practically inevitable), be transmitted directly up through the piles to the building. For this reason it is advisable that deep basements should be avoided.

Steel columns should be placed in a straight line in either direction so that at every panel there will be a maximum number of points of resistance. Moreover the sections of these columns should be as wide as possible in each direction and should be connected at each floor by as deep girders as head room will permit. In this manner it is possible to avoid the use of knee braces. Rivets which are "in tension should be carefully avoided, and instead, whenever possible they should be used in such a position that they are in shear."

If concrete is to maintain the splendid reputation for use in earthquake zones that has been awarded it by the gruelling tests of the Japanese catastrophe it is recommended that it be used only after careful screen analysis of the aggregates available, and the water content should be kept down to such a low minimum that the concrete can only just be worked into the forms. It is believed that exterior piers around steel columns should be made of reinforced concrete, while interior columns and connecting girders should be entirely covered with concrete reinforced very thoroughly both around the columns and longitudinally. Solid reinforced-concrete walls should be used in the interior between columns as well as around elevator shafts, pipe shafts, and stair wells. Lastly, wherever possible, reinforced concrete walls should be built from basement to roof, with a minimum number of openings.

It is an interesting and perhaps significant fact that the two most modern materials used for large industrial and public buildings, namely, steel and reinforced concrete, should also prove to be the best adapted to survival in a region where it is necessary to float the foundation on resilient shock absorbers in order to avoid periodically complete destruction at Nature's unpredictable whim.



A steel building in Tokyo which survived the recent earthquake without permanent damage. Although the right and left swaying motion set up stresses that sheared the outside walls in two corresponding systems of parallel fractures, the steel framework was strong and elastic enough to return to its original form after the last tremor. Demolition will be unnecessary in this case. Steel and reinforced concrete withstood the earthquake shocks best

The Continuous-Traffic Lift Bridge

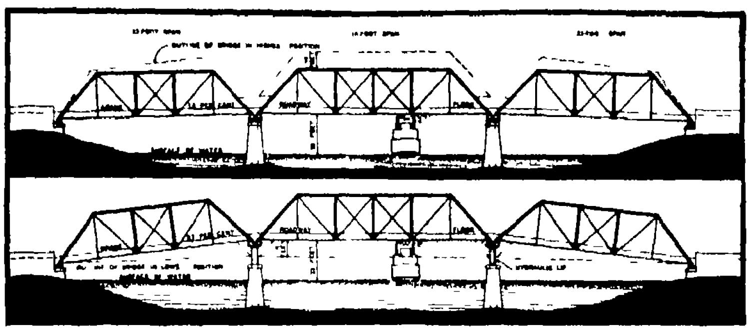
IN order that bridge traffic may not be interrupted by the necessity of keeping a clearance great enough beneath it to permit the passage of water-craft, a new and unique type of bridge has been designed by Mr A. A. Henderson, an engineer of Pittsburgh This bridge does away with the alternative necessity of building a span at so great a height above the street level that a costly and steep approach must be made The bridge may be raised in the center with hydraulic jacks permitting full clearance below for navigation during flood time and at the same time interposing only a low and temporary grade for the approach of bridge traffic This bridge is not, at least not in the usual sense of the word, a lift bridge. Rather is it designed to be raised only in time of high water, and then to be kept raised until the water subsides

With the center span and the adjacent ends of the shore spans raised there will be, of course, a gap at the shore ends of the latter Ordinarily this gap will be surprisingly small, introducing no new feature not regularly met with at the expansion joint of all large bridges In the case of a specific bridge of this type which was designed for the Allegheny River at Pittsburgh, having a center span of 410 feet and two shore spans of 333 feet each, with a total lift of 11 feet this gap would be only three inches, and could be readily provided for The gradient caused by the tilting of the two shore spans, with the jacks run up all the way would in this case be 5 7 per cent But a study of waterlevels at that point shows that there would be very few days in the year when the waterlevel in the river would be so high that the jacks would have to be fully run out

During 185 days of the year, corresponding to the period of low run-off the bridge would not have to be raised at all while a full extension of the jacks would be required during only 39 days of the entire year The jacks necessary to lift the total load, static and live of 5600 tons would consist of plungers of 32 inch diameter working under a three or four thousand pound per inch pressure delivered by an automatically controlled pump In order that the load may not continue to rest on the water in the cylinders after the bridge is raised, four 20-inch follow up screws are placed near the jacks so that the static load can be transferred to them

Similar hydraulic jacks are being used in the canal boat lift at Les Fontenelles France, on the Nuef fossé Canal, where a ram supports a weight of 800 tons on a diameter of six feet six inches with a a run-out of 48 feet

In order to provide for the transverse and longitudinal forces of wind etc, it will be necessary to have short steel guide-towers at the ends of the two piers so designed and constructed as to form a component part of them



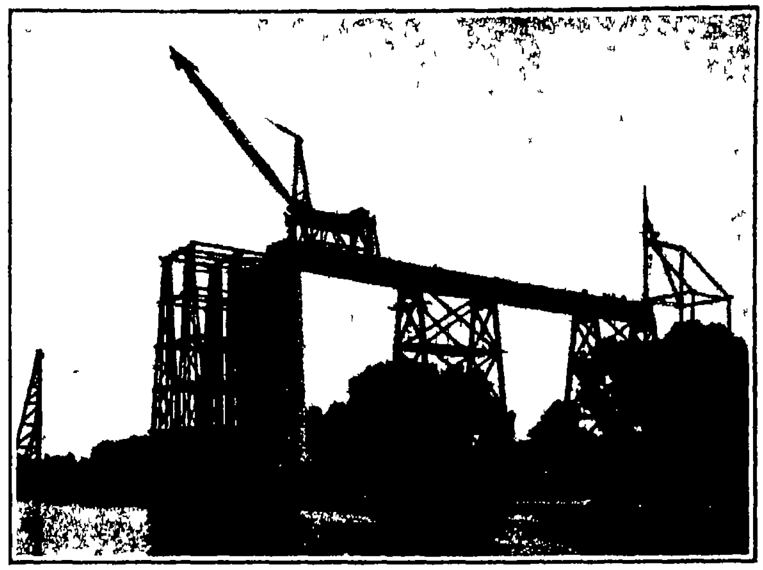
Hydraulic lift bridge proposed for rivers with a full spring stage of water, to permit passage of boats without interrupting traffic or requiring a bridge of excessive clearance

Bad Coal Ruins Family Wash

SOME housewives, mainly those living in large cities, recently had the unpleasant experience of having laundry ruined that had been hung out to dry Silk shirts or dainty underthings have shown brownish stains, and frequently, on ironing the garments the cloth has broken through at the discolored places, of course rendering the garments useless.

The cause of this distressing phenomena is now revealed The discovery was brought about through complaints made to the wet wash laundries by customers who had had the experience just mentioned with clothes that they had sent away to be washed

Chemical examination of the brownish spots disclosed the presence of sulfuric acid While the chemists who made the tests are not prepared to formulate the exact chemical reaction that takes place they believe that the acid is produced from the conversion of sulfur dioxide (SO_2) in the atmosphere into sulfuric acid (H_2SO_4) in the presence of the moisture in the wet garment The sulfur dioxide is easily accounted for as a by product from the consumption of poor grades of coal, the gas being conveyed by smoke coming from the chimneys As further proof of the correctness of this explanation it is worth noting that the trouble has been found to occur mainly on cloudy days, when there is a tendency for smoke to descend Again when garments come from the laundry already dried ready to be ironed by the housewife, the stains are absent, for the laundries dry indoors



New rail bridge across the Hudson below Albany, now under construction

Cutting a Traffic Tangle With a $20,000,000 Bridge

THE awful bottle-neck on the New York Central Railroad at Albany where every pound of freight and every passenger between the West and New York or Boston have to pass over a very limited number of tracks will be measurably relieved by the new bridge at Castleton ten miles south of Albany, now under construction The bridge will afford a connection between the West Shore and the New York Central lines without passing through the Albany station of the latter road Although actual work began only a year ago last June good progress has been made as our picture shows The completed bridge will be higher than the Poughkeepsie span and longer than the Brooklyn Bridge

Ninety-Eight Tons of Steel in One Piece

THE heaviest as well as the longest steel bridge girder ever used in bridge construction in America was recently swung into place over the Mississippi river at Rock Island Illinois This steel monster is 114 feet long and weighs 98 tons Its removal from the foundry where it was fabricated required the use of four flat cars and it is said to be the maximum weight that any foundry could produce in one piece

The girder spans a slough of the Mississippi river and forms the last link in a new bridge designed to carry traffic at this point for the next 50 years At this point, traffic is heavy and the movement between trains is short The ordinary expedient of diverting traffic to a temporary track could not be made use of The old super structure was removed and the new one erected without interfering with regular railroad traffic to any considerable degree One track was taken out of service during the day but was in service again when the working day was over

The completion of this bridge, which is expected to progress rapidly, will make possible greater electric power, as the new type of bridge will give full power to the stream current.

Placing a 98-ton girder near Rock Island, Ill.

Dog Distemper

DISTEMPER is an acute highly contagious disease presenting symptoms somewhat analogous to measles in man While some have regarded it as specific for the dog others consider that it occurs in cats young foxes, wolves jackals hyenas and even monkeys From its contagiosity it is certain that the cause is a microbe of some kind, which however, has hitherto not been unmasked Indeed there is very little real scientific knowledge extant on the disease This is in part at any rate due to the fact that what veterinary surgeons and the laity call distemper is almost certainly not one but several diseases That one of these is the specific disease is however, very probable

At present the concept of 'distemper' is entirely clinical Thus one finds descriptions in the literature of catarrhal gastric nervous and exanthematic types of the disease There is a great body of evidence to show that one attack of the malady confers a durable immunity on the survivor The disease occurs in all countries and was apparently known in antiquity On the other hand there is a tradition—it is little more—that distemper was introduced into Europe from South America in the seventeenth century There have been many researches on the probable cause and from the time of Semmer (1875) down to the present every known type of microbe has been incriminated

Many have believed that Carre came nearest the truth with the idea that the *causa morbi* is an invisible microbe which can traverse bacterial filters With filtrates obtained from nasal secretions he obtained lethal effects which were claimed to be identical with true distemper, and he regarded the visible bacteria found by others as secondary invaders

This view is largely accepted without criticism It may be pointed out however that Carre's work which is not given in any great detail, has been adversely criticised by Galli Valerio, and especially by Kreganow Filter passers have been suggested or proved for a number of pathological conditions They are highly infectious invisible filterable and non cultivable They probably constitute a new group of living things which if discovered in the case of distemper may throw a light on many unknown causes of disease in man

A Museum in the Open Air

The Display of Trees and Woody Plants at the Arnold Arboretum

By A A Hopkins

A bed of seedlings at the Arboretum

THE idea of a botanical garden is rather old. We had physic gardens in England and Friend Bartram's Garden in Philadelphia before the beginning of the nineteenth century and in that century were developed magnificent botanical gardens at Kew, in New York, in Java, in Ceylon and in many of the capitols of Europe. But it remained for the Arnold Arboretum at Jamaica Plain, Mass., to do away with the glass greenhouses, the invention of Sir Joseph Paxton, gardener of Chatsworth, the superb estate of the Duke of Devonshire. The botanical gardens referred to, of course, have trees as a part of their educational and scientific exhibits, but it is only a part of the whole. It remained for the Arnold Arboretum to develop a unique collection of 5000 varieties of trees and shrubs, and the number of specimens which one can see has never been determined. This unrivalled collection is the creation of one man, Dr. Charles S. Sargent, who has the unique distinction of being the only director of an institution which has flourished under one management for over 50 years, for he became the director in 1873 and still presides over this institution. We were fortunate to have the opportunity of spending a most pleasant day with Dr. Sargent who gave some very interesting information relative to trees which will be referred to later. It was inspiring to see great trees which he had planted and watched the growth of for decades. The handsomest example was perhaps a sugar maple which Dr. Sargent planted in 1885—39 years ago. This is certainly a very beautiful tree, but Dr. Sargent showed the writer larger trees which he planted in the first years of his directorate. This matter is very important as it shows the great crime which has been committed in the United States for 30 or 40 years of cutting down timber and never starting any reforestation. The newspapers and magazines are the greatest active enemies of trees, for the capacious maws of the pulp grinders seem to have no limit. We went to Canada the other day to see the largest paper mill in the world and the following is the statistics of wood consumption for one day: 400 cords weighing 960,000 pounds. Fortunately the corporation owning a great chain of mills has seen the light and they are planting. If Dr. Sargent had been heeded and the concrete example of the Arnold Arboretum had been taken at its face value, the economic resources of this country would have been conserved and a long train of evils which result from the displacing of nature's balances would have been avoided. Anybody can plant a tree and they require practically no attention—time is the only element. For trees to grow within the space of one man's life make it a certainty that if proper planting is carried on, that a forest tract may last for hundreds of years and supply all the wood necessary for building or industrial purposes.

Now to return to the Arboretum. The history of it is quickly told. A citizen of New Bedford, Mass., left $100,000 for the "promotion of agricultural or horticultural improvements," a splendid bequest. Harvard University became interested and devoted a large tract of land to the new enterprise: 125 acres in all and 90 acres were added subsequently. Dr. Sargent was made Director in 1873 and the Arboretum will remain as the undying memorial to the efforts of a true scientist who has had the rare opportunity to see his life work crowned with entire success. Besides his work of raising considerably over a million dollars, Dr. Sargent's own gifts of money, books, photographs and herbarium specimens have been princely. He has attracted students of trees from all over the world and a group of Chinese students studying trees is not an infrequent sight. The museum which contains the administrative offices, the library and collection of photographs, also can accommodate a herbarium of 1,000,000 sheets in steel cases and one of our engravings shows the bulk of 30,000 specimens obtained as a result of an expedition to Formosa and Korea in 1917-1918.

Arrangements were early completed with the City of Boston by which the Arboretum was fused with the Park System for a period of 1000 years, the longest contract of this nature of which we have ever heard. The city polices the Arboretum, takes care of the roads and walks and releases the institution from all taxes, and the people in return are free to wander at will from sunrise to sunset every day in the year. The opening and closing hours are regulated not by man but by the sun. At the time that the arrangement was made with the trustees of the James Arnold estate, the university undertook to grow in the Arboretum every tree and shrub able to support in the open ground the climate of New England. Nobody knew at the time what this involved as tree developing was in its infancy. It was necessary to find out what trees would grow out in Jamaica Plain and expeditions were sent all over the world to secure specimens to try out. The Arboretum was more than a garden of living plants; it was a great outdoor laboratory to increase the knowledge of trees in every possible way in all parts of the world. Expert advice as to landscape gardening was obtained from that master landscape gardener, Frederick L. Olmstead.

From other botanic gardens the Arboretum differs in its restricted purpose, for it is intended only for the study and cultivation of woody plants. Other public arboreta are parts of general botanic gardens and so sometimes suffer from the want of exclusive attention. In many countries individuals have planted collections of trees, but such collections have lacked scientific control and permanency, and sooner or later such collections disappear without leaving behind them any great addition to knowledge. It has been left to Harvard to establish the first garden which is exclusively an arboretum and which has the size and the promise of permanency necessary for success in its field.

As a museum of living plants the Arboretum occupies in West Roxbury 250 acres of rolling hills, narrow valleys and broad meadow. Natural woods of great beauty and interest cover a part of these acres, and among these woods the collections have been planted in natural groups of genera which are easily reached by grass-covered paths leading from the drives maintained by the City of Boston. There is a special collection of shrubs near one of the entrances in which the species of each genus are planted together for the instruction of visitors who may wish to use a shrub for some special purpose; other collections of shrubs are planted in connection with the trees to which they are related and in less conspicuous positions are arranged for trial and study. The library contains over 30,000 bound volumes and an immense collection of pamphlets.

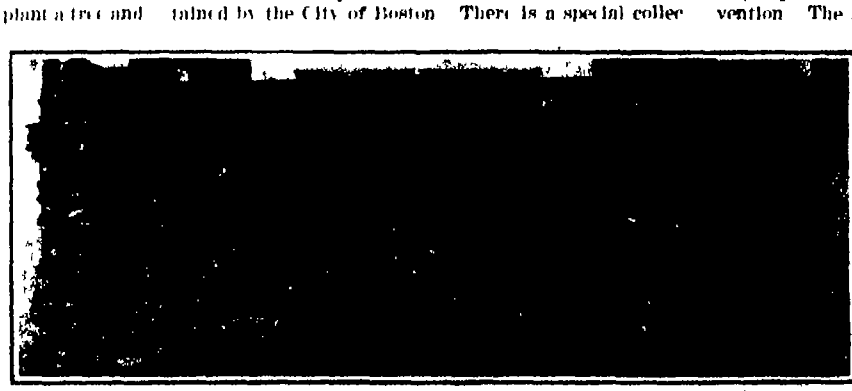
The Arboretum has stood as a great model and the Federal Government and many of the States have caused the planting of hundreds of thousands of trees based on the advice of the Director after actual experience in propagation of trees in a rather trying climate. Dr. Sargent called the writer's attention to a few facts which are not generally known. One of these is that no trees which grow south of the equator will grow in the Arboretum and that no oak, fir, beech, pine, poplar, hemlock, magnolia, birch or linden grows natively south of the equator. He also said that we have no monopoly in tall trees as our engraving shows. The Juniperus procera of Africa certainly compare with our great junipers in height and are a great source of the pencil lumber and the Taiwania cryptomerioides from Formosa grow to a height of 250 feet and are the tallest trees in Europe or Asia. The specimen shown is only 190 feet high and is still growing. Another fact which Dr. Sargent brought out was that trees which grow in the Andes within 50 feet of eternal snow are not hardy in New England.

Taiwania cryptomerioides, of Formosa, reaching a height of 300 feet

The tallest tree of Europe or Asia

Dr. Sargent has been a most powerful influence in scientific forestry in this country and it was a great treat to sit at his feet if only for a few hours.

The best advice we can give is when visiting Boston be sure to spend a few days or at least a day at this great museum in the open air where study is made easy by an elaborate system of labels and guide books and where the material for study is infinite.



Collection of 30,000 herbarium specimens made in Formosa and Korea during 1917-18

Educating Workmen to Accident Prevention

AN interesting scheme for the prevention of accidents by an adequate education of workmen has been devised by the German Syndicate of Civil Engineering Operatives. An energetic campaign was started at the beginning of this year consisting of the publication in each issue of the official organ of the Syndicate, of a set of instructive pictures illustrating, on the basis of accidents having actually happened, the main dangers workmen have to guard against. Without resorting to any detailed and tedious description, striking pictures are chosen which at a glance bring home to the most unsophisticated mind, what it is all about, explanatory notes being as concise as possible and reduced to the very minimum. A set of three drawings is given in most cases, the first of which shows the dangerous careless behavior liable to result in accident, while the second illustrates the accident as it actually occurs and the third the way of preventing it. In some cases, however, matters are so simple as to call only for two pictures—Figs. 1 and 2 being combined—or even for a single picture illustrating both the danger and its prevention. The series was introduced by two instructive preliminary diagrams illustrating the frequency of accidents with regard to the various parts of the human body and with regard to the various districts of the country respectively.

Inasmuch as professional dangers, especially those of accidents in connection with actual duties, constitute an important factor in the sum of influences impairing the health of a nation and, accordingly, reducing its efficiency, any attempt such as the one above described should be heartily welcomed, the more so as most accidents, with a minimum of care, are avoidable. Similar posters have been used in the United States for many years.

The Pasteurization of Milk

THE general enforcement of pasteurization of milk is called for in the public interest and there can be little doubt that, step by step this will come into operation. It is the most practical method of State regulation, and when carried out satisfactorily it secures immediate safety against serious risks of infection. For many years efforts to improve the sanitary conditions of the farm and the cow barn have been made, but with results which are quite incommensurate with the expense involved. By dirt tests, bacterial counts, insistence on cooling of the milk at the farm and allied measures, both the wholesale purchaser of the farmer's milk and the sanitary authority can do much to increase its cleanliness but pasteurization is the essential safeguard in the public interest. Attacks on pasteurized milk are not scientifically justified and they involve if successful a continuance of the supply of infective milk with the dangers at present associated with its consumption.—*Abstract from article in Nature for Feb. 3, 1923.*

Motor-Driven "Big Wheels"

ON the pine-clad plateaus of southern Oregon and northern California where ground conditions are favorable logging operators for many years have been using a unique method of yarding logs to the railway spurs known locally as the big wheel system. Briefly the method consists of suspending or balancing the load of one or more logs from the axle of a pair of giant wooden or steel wheels eight to ten feet in diameter. The tongue to which is ordinarily attached two or four horses is adjustable in length and extends several feet behind the axle. The slip tongue provides the required leverage for raising the logs clear of the ground and at the same time can be adjusted to keep the load in balance.

The steadily increasing cost of horse feed coupled with the short radius of economical yarding with animals has led one operator to experiment with motor propelled "big wheels," a picture of which appears in this connection. It will be noted that the application of the gasoline motor required the addition of two wheels in front to provide the suspension point formerly supplied by the animals and to offer a means of steering the machine.

The machine, which has not yet been named, consists of two big wheels 10 feet in diameter with 20-inch tread together with two power operated steering wheels six feet in diameter. The frame is built of I-beam structural steel with heavy steel castings. The big wheels are spaced nine feet eight inches from center to center and the inverted "U" axle has a ground clearance of six feet, the same clearance being secured between the steering wheels through the use of an automobile steering device. The machine can straddle a five-foot log and lift it nearly a foot from the ground.

A 90-horsepower motor mounted on the upper part of the frame where the gears, transmission and steering devices are also located, furnishes the power for both driving the machine and lifting the log. This power is transmitted to the big wheels through a specially designed transmission and gear and gives the following speeds with the engine turning 800 r.p.m.: low 1.78 miles per hour; intermediate 2.60 miles per hour; high 5 miles per hour.

The power is transmitted to the big wheels by an internal spur gear. A jack shaft receives the power through the gears from the engine and in turn transmits it to the big wheels through two gears meshing with two internal bull gears seven feet in diameter riveted to the rim and to the steel spokes.

The log lifting device is capable of lifting 20 tons with ease, and is so arranged that the entire power of the engine may be applied to it or released instantly in order that the log may be dropped when the machine is going down hill and serve as a brake. The log hoist is also equipped with brakes as is the machine itself. The power of the engine is applied to the hoist shaft through gears, and two chains carried on drums on the ends of the shaft are attached to the choker and passed around the log.

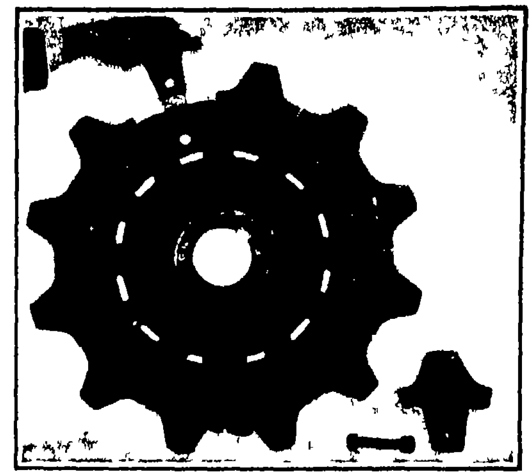
The load is then swung clear of the ground if desired or the rear ends of the logs are allowed to drag. The hoisting device locks until it is desired to lower or drop the load. The power is then transmitted to the big wheels and the machine moves forward.

How the motor has usurped the place of the horse in big-wheel logging

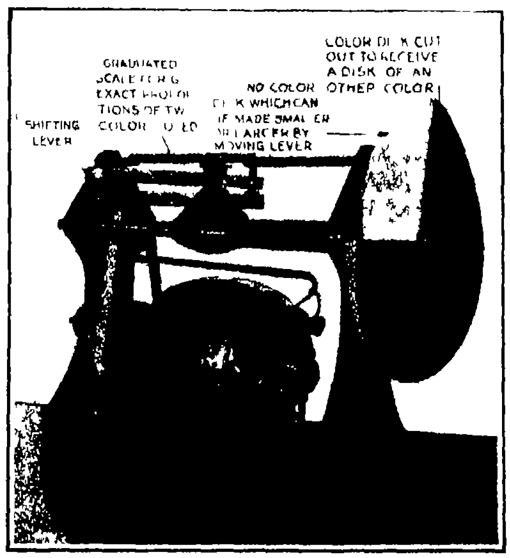
A Caterpillar Sprocket Wheel With Removable Teeth

A TRENCH machine has a caterpillar sprocket wheel made with removable teeth so that when it becomes worn the teeth may be replaced without the necessity of jacking up the machine and removing the caterpillar units in order to remove the worn sprockets from the shafts and replace them with new ones. The center of the new wheel is not subject to wear and therefore remains in place when once installed. The teeth are easily changeable while all other parts in the caterpillar remain in place.

A second feature of the wheel is the provision of sets of teeth in two sizes—the first a small size for use when the chain is new, and the second a larger set to provide for the elongation of the chain through wear. One of the larger teeth with the extra thickness of the rim section affects the circumferential pitch and takes up the looseness of the worn chain. This greatly increases the useful life of the chain.



Details of the caterpillar sprocket with removable teeth



The psychologist's color machine

Gliders

AIR Service Information Circular No. 444, published by the Chief of Air Service at Washington states that the combination of air currents and topography is the source of energy for gliding, but this energy is available in such varied and complicated combinations that it can not be studied in conjunction with the design of the glider. It should, however, be studied very carefully previous to and during initial attempts at soaring in order to determine whether soaring will be practicable over the regions selected and to determine the location of dangerous zones.

Declivity and thermic currents will be used at first. Attempts to use the internal energy of the wind will be made later perhaps when satisfactory automatic devices are developed to relieve the pilot of the burden of constant control operation which will be necessary.

No one type of glider has decided superiority over the others. Biplanes have high aspect ratio and small overall dimensions but have high parasite resistance and some interference effect.

Internally braced wings help to reduce head resistance, but high aspect ratio and rigidity are difficult to obtain and profile drag is high on thick wings.

Tail first types provide better protection for pilots and are otherwise as efficient as tail aft types.

In all cases the control should be more powerful than on airplanes.

Gliders will have value in training pilots, as observation posts, as targets and their use in sport for soaring will yield knowledge of meteorology which will result in the more economical use of commercial airplanes.

Topographical requirements for a declivity wind suitable for soaring are: A ridge of at least 200 feet in height with a length of one half mile. The windward side should be straight or concave. Convexity should be avoided for it will cause diverging air currents. The windward slope should have a grade of not less than 10 degrees and not over 20 degrees. The windward approaches should be clear of trees and brushes for at least one-half mile away in order to give smooth air flow near the ground and a good landing place.

Trees and brushes will reduce wind velocity and make the landing speed relative to the ground greater. This is the more serious because the glider in passing from a zone of moving air to one of still air will tend to drop very fast and lose lateral and longitudinal control at the time they are most needed.

The back of the ridge should be as horizontal and clear of trees as possible to make landings easier. If the angle between the windward and leeward sides is greater than 15 degrees burble vortices may be present.

Machine for Determining the Psychology of Color

THROUGH the invention of a unique differential or two-way color wheel by Dr. E. B. Twitmyer of the Department of Psychology of the University of Pennsylvania a problem which has defied the efforts of scientists for many years has been solved. It is generally known that the study of the psychology of color is important in many industrial fields, the textile trades, the advertising fields, etc., and this newly perfected device permits of more delicate determinations of color combinations and color effects than were ever before possible.

One of the remarkable features of this machine is that exceedingly fine adjustments of color relations can easily be made on a whirling disk while the machine is in motion. For example, a yellow disk is placed on the color wheel, and over this is partly placed a blue disk. The two colors blend when the wheel revolves and the proportions of each color can be shifted by the operator without removing the disks or stopping the machine, this work being done with the aid of an ingenious system of levers and cams. The various disks are cut out in such a shape that makes it an easy matter to move one within another. At the top of the machine is a graduated scale which automatically registers the exact proportions of the two colors as adjustments are made.

Not only does this machine make all kinds of color mixing an exact science but it also makes psychological tests of color combinations and values possible. For example, in cases of advertising literature in colors, commercial art work, colored posters, etc., the machine can be used to determine the correct proportions of color for each subject, thus preventing errors as to the application of too much bright color in combination with a darker color. Brilliant colors like red, yellow and orange are often too liberally used in commercial advertising, house decorating and in other arts and the new color wheel is capable of pre-determining the proper colors and proportions of color in every case.

When in actual use, a gray background is placed behind the whirling disk of the machine and a box-like arrangement fits over the front allowing for a variation of lighting effects somewhat like those on the stage of a modern theater. By means of these lights and the disks of all the principal colors many important facts relating to color are clearly demonstrated.

The Blue Ribbon of the Atlantic

Rapid Growth in Size and Speed of Turbine-Driven Ocean Liners

SO MUCH deplorable and unnecessary confusion was injected last year into the question of the relative size and speed of passenger ships that we are writing this little story so as to place the exact truth before the readers of the SCIENTIFIC AMERICAN Our facts have been gathered from the builders and operators, naval architects engineers ships log books and the records of the companies of each individual ship

The table of silhouettes below is drawn to a common scale It should be explained that the best all day speed has been achieved sometimes to the eastward and sometimes to the westward and that it was not always made on the day of the longest run

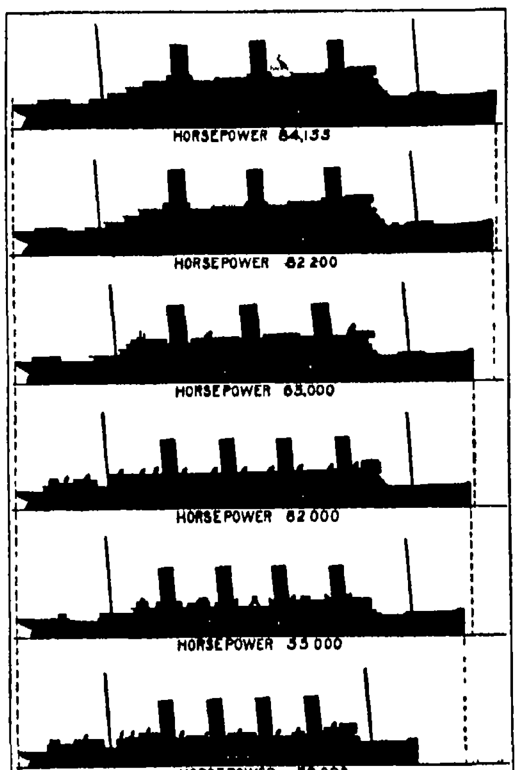
It is a curious fact that though the largest of these six ships is also the latest to be built the fastest of them the Mauretania was the first to be built and hours and 2 minutes or less than 5 days These records have never been surpassed on the Atlantic route and they were made with coal as fuel This winter she is being equipped for burning oil fuel, and it is probable that during the next season of 1924 she will show an even finer performance Her superiority in speed to the 'Majestic and "Leviathan' is due to her remark ably fine lines, and to the fact that with one-third less displacement she has only a little less horsepower

When the White Star Line decided to place two new ships the "Titanic" and Olympic in service, they made no effort to match the speed of the "Mauretania," and aimed rather at great size and comfort The length was raised from the 790 feet of the "Mauretania' to 886 feet the beam to 92 feet, 5 inches, and the displacement to 53 500 tons The turbine drive was adopted only in part, the motive power consisting of two turbine engines each driving a wing propeller and a central reciprocating engine With 55 000 horsepower this ship has made an eastward passage in 5 days, 12 hours and 38 minutes at an average speed of 22 61 knots Her biggest day's run is 559 miles, and the best all day speed stands at 23 10 knots Originally a coal burner she was altered to oil burning in 1920

Three years later, the Hamburg American Company put in service the first of a trio of great German liners the "Imperator" which now is sailing under the Cunard flag as the Berengaria" She was the first ship to exceed a length of 900 feet and her displacement at 39 ft draft is 63 090 tons The passenger accommodation was increased by the addition of one deck more than was found in previous large ships She is driven by the same Parsons type of turbines, driving four propellers which was introduced on the "Lusitania" and "Mauretania" She cut down the time of the eastward passage to 5 days, 10 hours and 50 minutes, making an average of 23.40 knots throughout the run The best day's run to her credit is 577 miles to the westward, when she averaged 23.55 knots with a horsepower of 65,000

It should be noted that although the length of the "Berengaria" over all was originally 919 feet, it is now 909 feet This is due to the fact that the Cunard Company removed the enormous bronze eagle with which she was adorned, whose beak projected ten feet beyond the bow of the ship In the following year (1914), the Cunard Company added to their fleet the "Aquitania," 901 feet on deck by 97 feet beam and a displacement of 53,176 tons on a maximum draft of 36 feet 3 inches Her fastest trip to date was made to the eastward in 5 days 11 hours and 28 minutes, at an average speed of 23.51 knots Her fastest day's run was 602 miles, made on her first voyage to the west ward, when she averaged for that day a speed of 24.32 knots with 62,000 horsepower The "Aquitania" is one deck less in height than the "Berengaria," and because of her lower freeboard and upper works, looks her length more than the bigger ship Like the 'Lusitania," the "Aquitania' is equipped with Scotch boilers and quadruple screw Parsons turbines, and in common

SILHOUETTES TO SAME SCALE OF SIX FAMOUS LINERS



Length on Deck	Breadth	Draft	Displacement in Tons	Fastest Passage	Average Speed for Whole Trip	Best Single Day's Run	Best All day Speed
956 ft	100 ft	39 ft	64,800	D H M 5 5 21 Eastward	24 76 knots Eastward	609 miles Westward	25 66 knots Eastward
950 ft	100 ft	39 ft	64 100	D H M 5 7 20 Westward	24 17 knots Westward	617 miles Westward	24 92 knots Westward
909 ft	98 ft	39 ft	63 090	D H M 5 10 50 Eastward	23 40 knots Eastward	577 miles Westward	23.55 knots Westward
901 ft	97 ft	36 ft 2 in	53 176	D H M 5 11 28 Eastward	23 51 knots Eastward	602 miles Westward	24 32 knots Westward
886 ft	92 ft 6 in	35 ft 6 in	53 500	D H M 5 12 38 Eastward	22 61 knots Eastward	559 miles Westward	23 10 knots Eastward
790 ft	88 ft	36 ft 2½ in	41,590	* D H M 4 10 41 Westward	26 06 knots Westward	676 miles Westward	27 04 knots Westward

Dimensions of Transatlanic Liners and Their Best Ocean Records

*This record made between Queenstown and New York Had she sailed over the Cherbourg New York route at the same speed her time would have been 4 days, 23 hours, 2 minutes

it should also be noted that with the exception of the Olympic,' all the vessels constructed throughout the 17 year period under consideration carry the same type of motive power The opening of the twentieth century found the German companies in possession of the blue ribbon of the Atlantic which was held jointly by the Deutschland and the "Kaiser Wilhelm II These ships with reciprocating engines of from 35 000 to 40 000 horsepower and a speed of 23½ knots on a consumption of 1¼ pounds of coal per horsepower per hour reached the high water mark of reciprocating engine development

The Cunard Company built the 'Lusitania' and Mauretania to win back the trans-Atlantic record, and they made the bold venture of equipping these ships with the then comparatively new steam turbine They were an immediate success and raised the trans Atlantic speed by 2½ knots the Mauretania' making the trip from Queenstown to New York in 4 days 10 hours and 41 minutes at a speed of 26 06 knots and covering in a single day of that run a distance of 676 miles at a speed of 27 04 knots Had the "Mauretania,' on that trip, started from Cherbourg and followed the usual course, her time would have been 4 days, 23

with all of the big ships she has made the change from coal to oil firing

In the same year, 1914, the Hamburg American liner "Vaterland" made her maiden trip to New York Of the same general type as the "Berengaria," she came from the drafting board of another designer, and is not only a larger vessel, being 41 feet longer and of two feet more beam, but the provision of a cruiser stern and a general refinement of her lines, with certain improvements in the motive power render her a faster vessel Like the "Berengaria," she has 46 water-tube boilers, and four screws driven by direct-connected Parsons turbines. After doing great service as a transport for American troops during the war, she was thoroughly overhauled and reconditioned, equipped with oil firing and placed on the Atlantic route under the Shipping Board. Her length is 950 feet, beam 100 feet and on a draft of 39 feet she displaces 64,100 tons. During her service between Cherbourg and Southampton, she has performed very consistently, and on her last trip to the westward she captured the record with a run of 5 days, 7 hours and 20 minutes at an average speed of 24.17 knots. On several days she covered

(Continued on page 144.)

A Hack-Saw Blade That Improves With Age

A NEW type of hack saw blade made of 18 per cent high-speed tungsten steel, hardened throughout, is shown in the accompanying illustration. The peculiar form of teeth will at once be evident and as the patent set extends beyond the root of the teeth the blade can be sharpened until the original teeth have been entirely ground away and the new teeth formed will still have sufficient set to clear themselves while sawing. It is interesting to note that the blades cut progressively faster after each sharpening.

The new hack saw blade can be sharpened on any suitable grinding machine, but that illustrated is specially arranged to secure the correct form of tooth for quick cutting. The wheel trued by a diamond to the correct angle remains in a stationary position. The blade, moving towards the wheel in contact with the models as shown in the close-up view, has its teeth always ground to the most efficient shape while the teeth are ground on both faces. While a blade with ordinary set can be ground three or four times at most the type under review can be ground twenty times so that its economy in use is obvious. Further the blade actually improves with regrinding.

A cutting machine fitted with one of these blades has a capacity up to 10 inch round bars. It runs at 170 r.p.m. and puts a heavy pressure on the blade. The saw holders have an indicator to show correct tension on the blade and a special arrangement to enable a start to be made on a sharp corner without danger of breaking the teeth and for cutting a groove before full pressure comes on the blade.

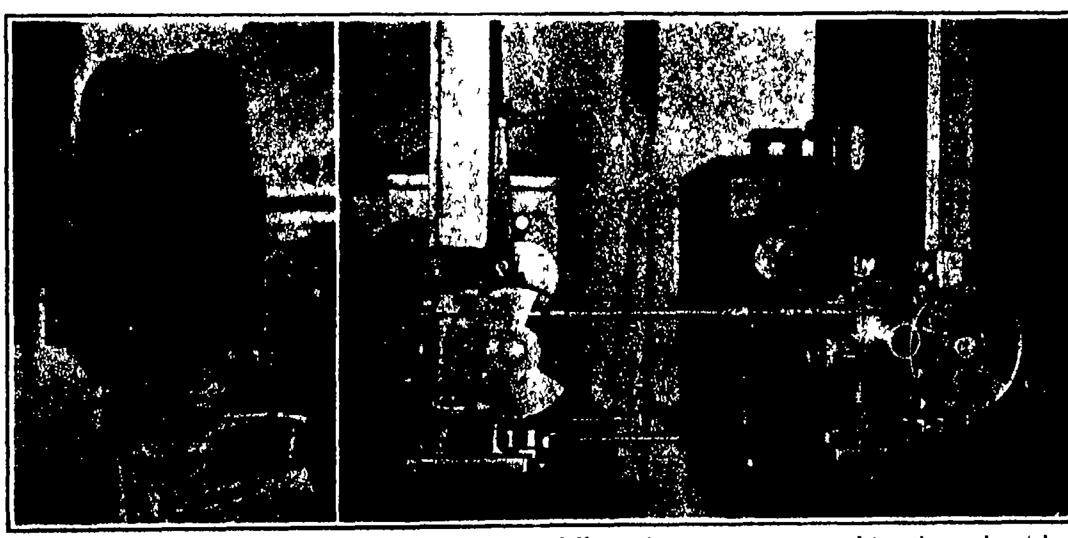
The capacity of this machine fitted with these special blades is remarkable.

Special machine for resharpening the special hack-saw blades which are shown at the right. These blades may be sharpened several times and even improve with age

Doubling the Field of Vision of the Movies

THE lens of the ordinary motion picture camera has an angle of view of thirty degrees. A motion picture camera recently invented, on the other hand has two lenses so arranged that they act in the same plane and have a combined angle of view of sixty degrees. This camera does not need to be placed more than 20 feet from the "set" or scene, and every shot is practically a "close-up." Because of the wide angle of view of the combined lenses athletic events, such as football, baseball and similar scenes can be shown with the entire field in one picture and with close-up value.

The new motion picture camera carries two rolls of film and takes simultaneously two views in the same field which are united in projection, making a perfectly matched-up picture that takes in twice as much field of vision as any other camera. When it comes to projecting, two projectors are used, connected by a simple attachment so that they work in unison. When these twin projectors are employed a 30-foot screen will replace the usual 15-foot screen. The eye-strain caused by looking at motion pictures will be nearly done away with, as the 60-degree angle of view obtained by this method is almost that of the human eye, which is 65 degrees.



Two lenses recording matched-up images on two rolls of film, and two projectors geared together and matching up their screen images, produce "movies" twice the normal width

It is held by the inventor of this new wide-angle cinematography that the educational value of the motion picture will be greatly enhanced by this invention as there will be much less breaking up of continuity, more background and more atmosphere in the pictures. Not only will the new pictures be much more real in a dramatic sense, as indicated by these suggestions but the nearer realization of the angle of vision of the human eye will insure that they will look more like the things we see by direct vision.

Seeking a Non-Destructive Method for Testing Wire Rope

THE various factors which determine the life of a wire rope in hoisting service frequently affect the inner structure of the rope and the result is not evident from visual inspection. For this reason it is difficult to estimate the remaining strength of a rope which has been some time in service. It is the present practice to retire a rope from service when in the judgment of an experienced inspector its remaining strength has fallen below a certain percentage of its original value. The relatively small number of accidents which can be traced to rope failure gives evidence that it is customary to err on the safe side by removing the rope from service long before its capacity for useful work has been realized. This of course is a safe practice but leads to an economic loss which could be avoided if a satisfactory method for testing the rope without injury and without danger of an over-estimate could be applied.

The Bureau of Standards is now investigating the possibilities in the way of a non-destructive method for testing wire rope in service. Such a method must obviously be based upon correlation between the strength of the rope and some physical property or properties which can be measured on the rope in place and without injury to its structure. External wear and corrosion are easy to detect by visual inspection but a successful method for test must indicate also the result of internal wear and corrosion which are not visible, as well as fatigue and overstrain which actually change the properties of the material and thus alter its strength.

Magnetic tests would appear to be most convenient of application and consequently are being given first attention. Indeed, there have been previous attempts of promise to correlate magnetic permeability with tensile strength. The fundamental relationships between the mechanical properties of the material of which wire rope is made and its magnetic properties will first be studied in order to determine whether or not a magnetic method could reasonably be expected to work. If such correlations can be established, it should be a simple matter to devise apparatus which can be applied to hoisting ropes in place and which will supplement the present methods of visual inspection or even replace them entirely.

Truck News From Abroad

A MOTOR rail train comprising a five-ton truck chassis and trailer is being used successfully in the Mildura District of Victoria, the dried fruit center of Australia. The main car carries 65 passengers and the trailer 10, the trailer being devoted mainly to freight. This train makes four round trips daily between Mildura and Merbein at an average speed of between 30 and 35 miles an hour over tracks of the Victorian railways. The steam train which it replaces made only two daily round trips. With gasolene selling at 72 cents per imperial gallon the cost of running this motor train is only about 14 cents per mile.

The use of motor trucks in hauling copper ore in the Belgian Congo has proved successful. The Director-General of the Union Miniere has given this means of transportation a trial with the idea that at a cost of four francs per metric ton kilometer it would be profitable to change to motor transportation. One American truck has been able to haul copper ore at a cost of 1.08 francs per metric ton kilometer.

Three motor bus lines are now being operated between Damascus and Beirut, Syria. One of these is being managed by a railroad company which has a rail line running between these points. There are also two bus lines between Damascus and two other cities. The privately owned cars registered in this area now number about 160 as compared with about a third that number a year ago. The American consul in this territory reports that the demand for motor transport is on the increase.

The most important regulation in the motor vehicle law of Jamaica prohibits the importation or use of any motor vehicle exceeding fifty hundredweight (about two and one-half tons) except upon conditions decided by the governor in privy council. This would indicate that all commercial vehicles except light delivery wagons and three-quarter to one-ton capacity trucks would be barred from the highways of the island.

Taxicabs will make their first appearance in Hongkong this summer. The Government approval for the inauguration of the service has already been obtained and the projected plans provide for a fleet of thirty cabs which will eventually be increased to 200 distributed over the important points of the colony. The lack of transportation facilities commensurate to the growth of Hongkong has been the chief factor in the establishment of this motor service. The city is built on a very steep slope, and at present the principal methods of transportation are jinrickshas and sedan chairs drawn or carried by coolies. Owing to the competition from the low priced jinrickshas the charges for the new service have been made quite reasonable.

With Camera and Chisel

Still Another Form of Photo-Sculpture in Which Simplicity and Efficiency Go Hand in Hand

By J. Hammond Smith

Professor of Engineering, University of Pittsburgh

The late President Harding seated beside his photo-sculpture bust, which is one-eighth larger than life size

SCULPTURE produced in remote ages was crude because the means for reproducing the forms of nature were also crude The methods of measuring and the tools for carving were probably invented and made by the sculptor himself These were very poor and used without much skill, as the workman rarely passed the stage of the amateur, there being little fostering demand as an incentive to continued effort As the development of sculpture is traced down through the ages, it is found that quality is closely linked with the means for producing and the incentive for continued effort of the sculptor, in the form of livelihood honor, and appreciation of his work

Development of the art down to the present time has produced many "schools" of sculpture copying after the master sculptors who have specialized in the development of certain features In many cases the devoted pursuit of the conventionalisms thus introduced have retarded the development of true art Those who have taken nature itself as their true guide have made the greatest progress

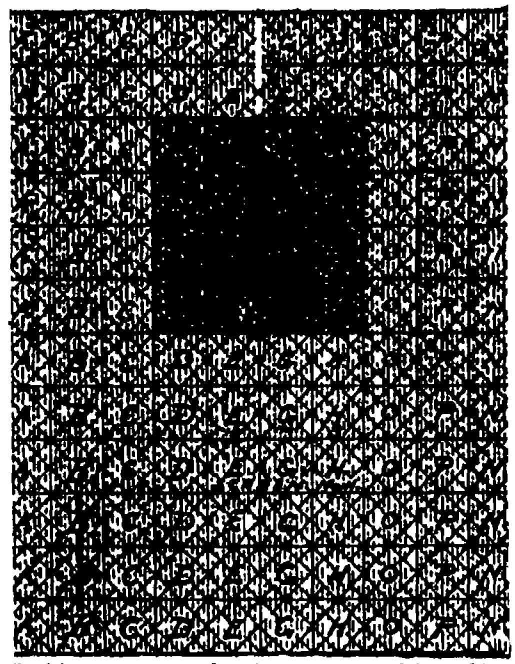
Most well informed wide awake progressive and up-to-date sculptors of the present are unprejudiced against new developments tending to refine and improve their art Yet there are many who still use the methods of the old sculptors making many crude measurements and compelling their models or patrons to pose for hours and sometimes days before the production begins to assume the form of a likeness

The arts have reached a stage of development where an admixture of science is recognized as a means of producing a most stimulating effect The chemistry and color effects of artist's paints, art glassware, art china stained glass and the electric illumination of paintings, frescoes lamps fountains and art glass are only a few of the many applications of science to art In most of these cases, art is indebted to the true men of science, for, truth to tell, very few of the unaided artists would, without the aptitude and special training required, have been able to evolve these improvements.

Thus it is that a scientist of the University of Pittsburgh has worked out photo-sculpture, a most remarkable advance step in the art of sculpture Several years have been devoted to the development of the original idea, until now the method and apparatus are in smooth working, practical form There have been other similar systems of photo-sculpture developed abroad and described in past issues of this journal

The present photo-sculpturing device is simple consisting of a center rotating stand and two "camera projectors" The center stand may be rotated about a vertical axis and stopped in any desired position. A chair for the subject is attached to the top of the stand when making the photographic records of form a modeling stand replacing the chair during the building or carving of the statue The two camera projectors are alike excepting in details, and, as the name implies, may be used as cameras or slide projectors For work of reasonable size such as portrait busts they are set pointing toward the center stand several feet distant, and several feet away from each other, so that their optical axes form an angle of ten to forty five degrees, having its vertex on the vertical axis of the center stand

In making photographic records of the subject one camera projector is used to project the screen This screen is simply a system of markings on clear glass, and is projected upon the subject as a lantern slide



Positive print from the glass screen used in making record photographs

The other camera projector is used as a camera, taking pictures of the subject while under screen illumination, as shown. Any number of these pictures may be taken to get the record of the subject on all sides, but four is ample for a portrait bust Now these photographic plates, in conjunction with the screen, embody a very accurate and complete record of the form of the subject These permanent record photographs may be used at any time for the production of the statue, the record of which is virtually contained within them.

In the production of statuary, the record photographs, usually in the form of the original glass negatives, are used one at a time, by projecting them from the same position as they formerly occupied in the camera-projector, when the photographs were made For each marking (letter, line, etc) found on the photograph, a corresponding marking will be found on the screen, because all markings on the photograph were produced by the projected light passing through the screen to the subject and there being reflected back into the camera to the photographic plate Therefore it may be readily understood that if both photograph and screen are projected simultaneously, the light beams from corresponding markings will cross in space at points where these beams were reflected from the subject to camera, when the photographs were made Therefore, if material such as clay, be built on the modeling stand, at the point where these corresponding light beams cross in such a way as to cause the image

(*Continued on page 144*)

Left Illuminating photograph which is made into a colored slide for the purpose of projecting a life-like image on to the finished bust. *Center:* One of the record photographs of the late President Harding showing the screen markings. It is from the record photographs that the bust has been made. *Right* Clay bust of the late President Harding, just after finishing by the photo-sculpture method

Three phases of photo-sculpture, beginning with the posing for the record photographs and ending with the finished bust

A Giant Among Airplanes

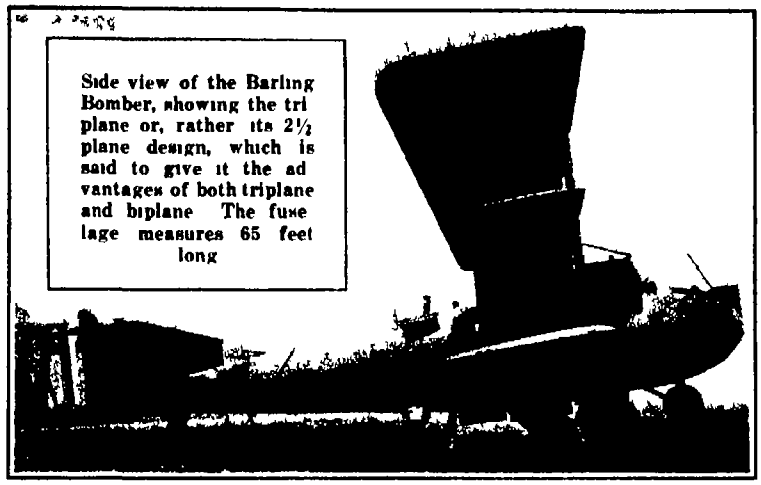
STAGGERING to the imagination is the mere suggestion that a 20-ton—40,000 pounds—airplane is being contemplated! Yet, in the recent completion of the Barling bomber at Wilbur Wright Field, Dayton, Ohio the largest aircraft in the world is an accomplished fact The immensity of its proportions suggests the tonnage of locomotives, bridges, buildings, or other earth clinging objects instead of a machine for navigation through the tenuous air

Barling Bomber—a large airplane measuring 120 feet from tip to tip and standing over 28 feet high. It weighs over 20 tons, yet it flies!

This Goliath of aircraft designed by Walter H Barling for the Air Service of the War Department has accommodations for safely transporting 5 000 pounds of bombs and could lift and carry for two hours, a 10 000-pound bomb Other than its liberal provisions for instruments and ammunition for aerial warfare, this air-going machine affords room for six tons or 2000 gallons of gasoline, 1356 pounds or 181 gallons of oil, and a crew of four or more persons. When loaded, the weight of this airplane exceeds 40 000 pounds, and it travels through the air at a speed of not less than 90 miles an hour

It is a triplane, or according to technical description a 2½ planer in that the arrangement of its aerofoils partakes of the advantages of both triplane and biplane The Barling bomber is 28 feet high its over all length is 65 feet, and from tip to tip of its wings measures 120 feet a pigmy compared to the 74-foot wing span of the largest bombing aircraft now employed by the Air Service A half-dozen Liberty motors are necessary to transport this 20-ton flying machine through space

Spruce said to be the choicest of all wood for aircraft construction is the basic material of this modern Titan The main wing fittings are fashioned of 60 000 pound steel which is deemed preferable to nickel steel of 150 000 pounds the latter being used in building "NC-4" the transatlantic airship of the United States Navy Department The tail skid is of all metal construction, and the rubber tired landing wheels are 12 inches through The fuselage round in shape is 65 feet long and 10 feet in diameter inside measurements



Side view of the Barling Bomber, showing the triplane or, rather its 2½ plane design, which is said to give it the advantages of both triplane and biplane The fuselage measures 65 feet long

The world's biggest airplane is scheduled to have a 12 hour full-speed flight capacity Seven guns may be operated from five positions or cockpits thus affording a sweeping range of the entire field in which the enemy aircraft may approach Then too gun defence may be augmented if daylight fighting instead of bombing after nightfall is contemplated The six 450 horsepower Liberty motors are controlled through a centralized control stick a feature of which is the stoppage of the engines on one side without reducing the driving force of the others The two pilots are seated side by side and they may frequently change their positions.

The building of aircraft of such enormous size was prompted by a threefold reason according to the Air Service of the War Department, namely, the development of an air-going bombing machine to meet fully military requirements making provision for a flying platform for experimental uses, and a realization of a step in the direction of big aircraft of the future Of the latter factor, the Air Service does not deem it visionary to contemplate that within the next decade an airplane will be developed having a capacity for transporting and dropping a 20,000-pound bomb. The latter, in the event of war, would rip a crater in the earth 50 feet in diameter and demoralize the warring civilian population The carriage of such a bomb however, would require the construction of a 200 000 pound airplane five times the dimensions of the Barling bomber Such a development according to the Air Service, is not improbable

Sulfur Corrosion

IN discussing alloys resistant to corrosion before the Faraday Society at Sheffield Mr T F Kayser said that practically all the trade pamphlets claim that the nickel chromium alloys they describe are quite resistant to the action of sulfur in furnace gases but as a result of trials with all the alloys at present available it had been found that such claims cannot be substantiated Tests made with single gases showed that some alloys would withstand the action of steam carbon dioxide carbon monoxide ammonia and even pure oxygen for indefinite periods without scaling Mixtures of those gases were also found to be quite harmless upon the alloys The introduction of either sulfuretted hydrogen or sulfur dioxide proved however to be fatal to even the highest grade nickel chromium alloys

A Device That Takes Care of Worn Brake Linings and Shoes

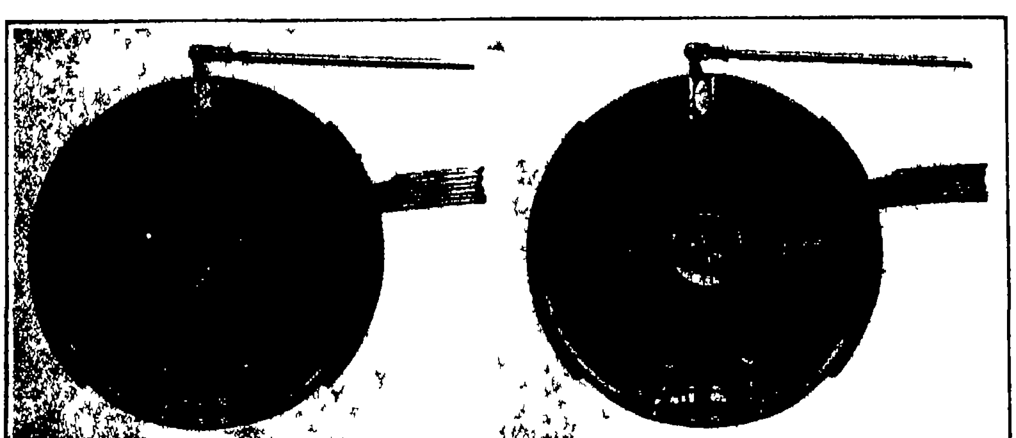
ALL brakes wear out in time In the case of automobiles and motor trucks the brakes consist of metallic parts and suitable brake linings so that some form of asbestos fabric is brought to bear on a metal surface The friction that takes place causes the asbestos fabric or lining to wear out in time and eventually the lining must be replaced. In the case of railway cars, the brakes consist of iron members called brake shoes, which press against the hard steel rims of the wheels In time these relatively soft iron brake shoes wear out and must be replaced by new ones

Aside from the question of gradual wear, it is necessary to adjust brakes for the best braking efficiency It stands to reason that as the brake lining or brake shoe wears the distance between the two braking surfaces becomes greater and greater Therefore the brake control must travel farther and farther in order to apply the same amount of pressure as when the brakes were new After a while it becomes necessary to adjust the brake rigging so as to compensate for the increased space between braking surfaces or it is necessary to move the braking surfaces nearer to each other

It has remained for an ingenious French inventor to work out an automatic compensating device for brakes This device consists of a simple combination of a coarse screw thread a wedge-shaped member and a casing designed in such a way that the device is elongated step by step in the manner of a ratchet mechanism when given the opportunity It stretches out as the linings wear down and compensates for the wear but it does not and cannot go back

In the case of the usual automobile or motor truck this automatic brake compensator may be inserted in the cable or rod controls leading from the lever or pedal to the brakes The device when given the opportunity by the wear of the braking surfaces elongates by one step of its one-way mechanism so as to keep the control cables or rods always the same length and tautness irrespective of the worn braking surfaces Again the automatic brake compensators may be mounted as shown in the accompanying illustration Here in the brake housing three compensators are employed and serve to spread out the expanding brake surfaces as the latter wear down so that the cam center shown at the top is always moved the same degree to obtain the proper braking effect

The automatic brake compensator can also be employed on railway rolling stock for compensating the brake rods for the wearing down of the brake shoes

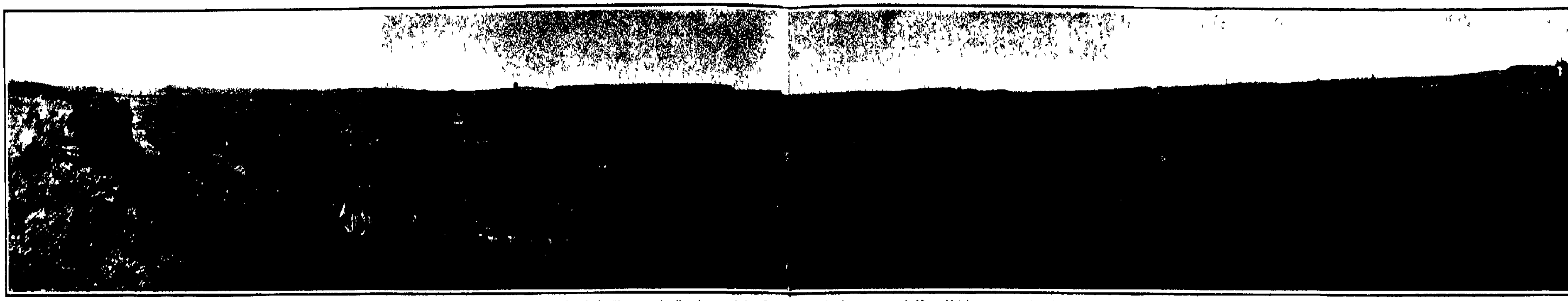


Expanding brakes of the usual automobile provided with automatic compensating devices. The left hand view shows the relative positions with new brake linings, and the right-hand shows positions with worn brake linings

Why Watch Springs Break

HARRY HOLTON a watch maker of Wells River Vermont kept a record of watch spring breakages covering a number of years and found that out of 75 breakages during that period 70 occurred following the winding of the watch at night Accordingly the following explanation of the cause of breakage was suggested A watch is carried all day and has acquired approximately the temperature of the body When removed from the pocket and wound quite tight the ensuing contraction caused by cooling off of the spring caused it to be strained and lengthened This effect it is suggested is cumulative and the spring finally gives way—usually during the night after the winding which supplied the straw to break the camel's back

Since one is more likely to get up at a more uniform hour in the morning than he is to go to bed at night it is better to wind the watch at that time as it gives a more even power behind the running of the watch Also a watch wound at night is half run down in the morning when the owner begins activities that cause various jars to the watch These little shocks are more likely to check a balance wheel if the full strength is not behind the spring



This is "Hull Rust," the greatest of all mines The 300 ton steam shovel, the 50 ton steel railroad car and the 176 ton locomotive have excavated this artificial canyon, 320 feet deep, 4000 feet in maximum width and $2\frac{1}{4}$ miles in length

The Story of Steel—II

Missabe—The Greatest Iron Mines and the Most Economical Mining in the World

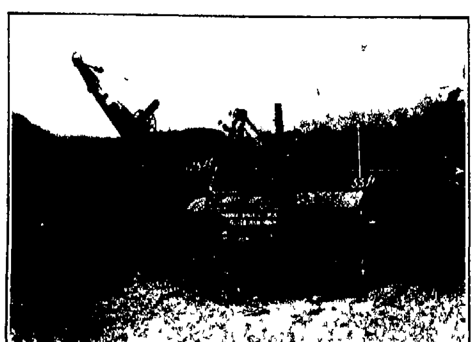
NOW and again something happens in one's lifetime which stands out in the long perspective of the past like some isolated hill in a landscape. Among such memories will ever remain the writer's first sight of the largest of the open-pit mines of the Missabe range to the north of the city of Duluth. It was in the early hours of a frosty October morning, after a drive through the mining town of Hibbing, that he dismounted near a small wood, passed through it and found himself on the edge of the greatest artificial hole ever dug by man in all the long ages of his history. Between 300 and 400 feet deep was that vast canyon and from its lowest level it sloped irregularly on either side up to the original surface of the ground leaving a gap three quarters of a mile in sheer stretch from edge to edge. For a full two and a quarter miles the awe-inspiring chasm yawned ahead, its further limits barely discernible in the morning haze.

The writer is not devoid of imagination, and he had heard of the Gargantuan proportions of the Hull Rust Mine; he had looked down into the great Culebra Cut at Panama; but for all that he could not repress, if he had wished to, a gasp of astonishment. Here was something which as a feat of excavation rendered even the Panama Excavation at its widest point modest by comparison. Culebra's largest cross-section is found where the big slides have opened out the excavation to a width of 1800 feet on a centerline depth of 240 feet; but at Hull Rust the steam shovel and the ore train had dug and dug and carried away until we have today a hole 320 feet deep at its lowest point and extending to a width of 4000 feet at its widest part.

But where are Hibbing and Hull Rust and why this enormous excavation, which, be it known, is only one of over a hundred mines scattered along the great Missabe iron range, which extends east and west for 112 miles? To answer that question we invite the reader to go by rail and lake steamer to the city of Duluth, which is built upon the steeply sloping bluffs that rise from the northerly shore of the lake. These bluffs reach a rather uniform height of 600 feet, and when the train, climbing on a two per cent grade, reaches the top of the bluffs the traveler finds himself on a great plateau which extends practically level to the Canadian boundary. Eighty miles inland from Duluth he will reach Hibbing, which is located at about the center of that vast stretch of iron-ore deposits known as the Missabe range. Fifty years ago this plain was given over to forest growth, and the occasional hunter who walked its solitary trails little imagined that under his feet and not so very far down was one of the greatest of the treasure houses of wealth which nature had locked up in far-distant ages for the future enrichment of mankind.

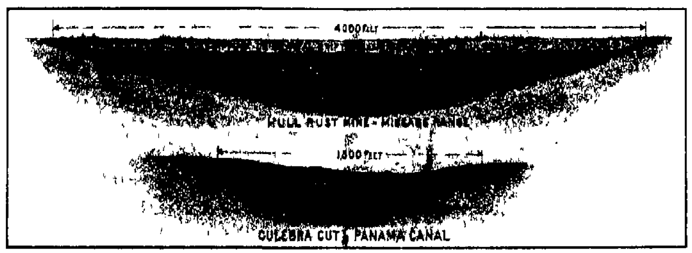
Iron must be placed at the top of the list of metals which have been found in this world, for it exists in greater quantity and has been put to more widely extended use than any other. You may find it in some measure in practically all of the rocks and earths, and we know how frequently a stream of water or even the water from a well will show the characteristic reddish deposit which indicates the presence of iron. The geologist will tell you that millions of years ago great volumes of water pouring through underground channels washed out of the various rocks and soils of the earth this rich deposit and by chemical action changed it into the characteristic red and yellow iron ore, which found a settling basin in the many hollow depressions which characterize the Missabe range.

Only a part of the world's iron deposits can be made into steel, for much of it is so mixed with other substances as to make it very expensive to melt down into iron by any method that man has so far been able to devise. Naturally the ores which are most cheaply reduced to iron are those which have been most sought after and mined, and the greatest deposits in the world of this character are those to be found in the vicinity of Lake Superior. Not only are these the largest, but they are richer in iron and less burdened with those more or less troublesome elements which always are found with iron ore, such as phosphorus, silicon, sulfur, magnesia, aluminum, etc. Iron ore is valued on the basis of the amount of iron it contains and also upon the amount of these elements that it contains and the cost of getting rid of them in the blast furnace. We present a map of the Lake Superior region showing in black the location of the various iron ranges, and in another drawing are shown typical vertical sections through these various mines. It will be seen at once that there is a wide variety both in the shape and lie of the ore bodies and that different methods of mining have to be adopted to suit the local conditions.



This 300 ton shovel makes a cut 40 feet deep and 175 feet wide. The dipper lifts 16 tons at each stroke; the 80 foot boom weighs 50 tons

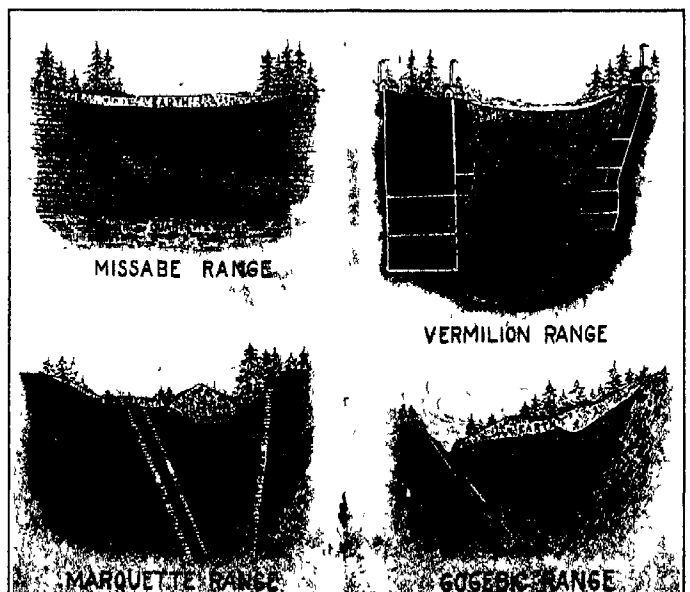
Now, although iron ore has been mined in the Lake Superior region from the middle of the last century onward, it is only of late years that the total output has risen to such great proportions as to give this country its commanding lead in the steel industry of the world; and among all the Lake Superior ranges the one which has contributed most to the growth of our steel industry has been the famous Missabe range, which, as we have said, extends in an easterly and westerly direction for no less than 112 miles. Not only are these deposits of enormous size, but nature has so placed them that it is possible to dig them out and remove them at a cost per ton far below that which is possible in any of the mining centers of the world. The ore bodies of the Missabe, as they were deposited ages ago, exist in more or less continuous beds which vary in width from a few hundred to thousands of feet, and in the Hull Rust and Mahoning Mines extend without a break for between four and five miles. These ore bodies vary in thickness from a few feet to over 300 feet and from a few acres to several hundred acres in extent. After their formation the great icecap came crushing and grinding its way down from the north, bringing with it a vast amount of sand, gravel and boulders, with which it covered up the ore to an average depth of about 70 feet. There it lay, a vast storehouse of wealth, locked up securely until the day when man should make his appearance upon the earth and develop to the point where he had the intelligence and the appliances to transmute this raw material of nature into the thousand and one steel products demanded by our highly developed civilization.



Hull Rust iron mine and Culebra Cut, Panama, compared at the point of their combined deepest and widest excavation

The first mining of iron ore in Minnesota was done with very primitive tools, such as could be packed from Duluth over a hundred miles of forest to the first mines on the Vermilion range. In the early eighties work was done with pick and shovel, hand drill and wheelbarrow; shafts were sunk and the ore was hoisted in buckets by a horse-operated winch and carted from the mouth of the pit in horse-drawn wagons. Then with the railroad came the steam engine, and a few years later the hand drill gave place to the air drill. Later in the nineties came the ore cage with its landing gates, the stockpile trestle, electric lighting, Corliss hoisting engines and an increase in the capacity of the railroad ore car to 25 tons.

Also in the early nineties, following the methods of the day in deep mining, the miners of the Missabe sunk shafts through the overlying glacial drift to the ore body below; but when it was found that the ore lay very close to the surface, the momentous decision was taken to strip off this overburden and take out the ore by scrapers and horse-drawn wagons. Finally came another momentous advance in the introduction of the steam shovel, and as an inevitable sequence to this came the determination to run the railroad cars themselves down into the open pit and load them directly from the shovel itself.



Cross-sections of the principal iron ranges of the Lake Superior district, showing the position of the ore bodies. Missabe is mined by "open-pit," the others mainly by shaft and tunnel methods

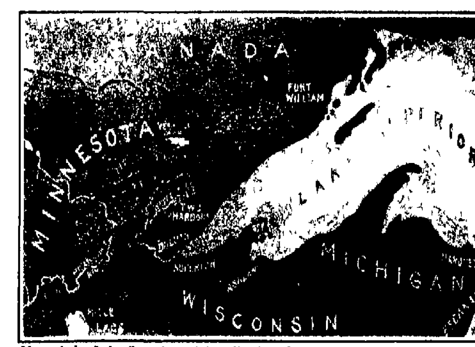
The system of open-pit mining having thus been started, the problem became merely one of applying the American principle of working with the largest units of machinery that could be built and operated. There was a steady growth in the size from the 35-ton pioneer shovel until the Oliver Iron Mining Company placed in the Hull Rust Mine the enormous Marion machine shown in one of our engravings. This shovel weighs 300 tons, and its dipper, lifting 16 tons of ore at one scoop, has 16 times the capacity of the dipper of the first shovel. The early dump cars were of wood and each carried one cubic yard. The present cars are built entirely of steel and each has a 30-cubic yard capacity. In place of the little six-ton "dinky" steam locomotive we have the huge modern locomotives with 100 tons of weight on the drivers, which handle the cars in the pit and haul them up the long steep grades to the main tracks above, where they are assembled in trains of 50 to 60 cars for transportation to the ore docks at Duluth.

In opening up a mine on the Missabe range, thorough exploration is first made by means of diamond or churn drills, and the depth of the glacial deposit and of the ore body below is closely determined. If the cost of stripping and mining by open-pit steam-shovel methods is found to be less than that of deep mining by shafts and tunnels, the open mining method is followed, as at Hull Rust. The operations involved in stripping off and removing the glacial drift are on an enormous scale, for they involve the removal of millions of tons of material to dumps that are located sometimes at considerable distances. Obviously the material must be deposited on lands which have no available ore below them. The spoil is deposited in dumps of Cyclopean proportions which extend for thousands of yards and reach pretty nigh to a hundred feet in maximum height. These accumulations are as wonderful in their way as the huge excavations from which the material is taken. When the ore body has been exposed, the steam shovels cut their way into it, the depth of the cut being governed by the height to which they can raise the ore and drop it into the cars.

In 1920, at the annual meeting of the American Institute of Mining and Metallurgical Engineers at Duluth, it was stated that since the Missabe range was opened there has been removed 354,301,371 cubic yards of stripping. Compare this with the total excavation of about 240,000,000 yards at Panama. The total stripping and iron ore together would make 364 city blocks, each 300 feet in height. There is a total known ore reserve at Missabe of 1,400,000,000 tons.

The combination of steam shovels of great capacity, large cars and powerful engines accomplish a great saving in labor, and the output per man per day from an open-pit mine is many times that from the average underground mine. In this respect the key to the situation is the giant steam shovel, whose huge dipper tears from the side of the cut a mass of ore weighing 16 tons and drops it into the cars at a height of 30 feet above the rails on which the steam shovel stands. The steel boom, which weighs just under 50 tons, is 85 feet in length, and the dipper stick, some 50 feet in length, weighs 18 tons. These figures explain the great horizontal and vertical reach of

(Continued on page 144)



Map of the Lake Superior mining district, showing location of iron ranges in black. The rich Missabe range extends for 112 miles

The Heavens in February, 1924

Stellar Distances, and Their Importance in the Astronomer's Work

By Professor Henry Norris Russell, Ph.D

KNOWLEDGE of the distances of the stars is essential to any successful study of their nature Without it, we cannot find how bright they really are, or how large or massive they may be but important as this information on distance is, it is far from easy to obtain For the nearest stars we can make use of direct methods, quite similar in principle to those used in finding the range for artillery—sighting on the star at times when the earth is on opposite sides of its orbit, and using the convergence of lines drawn to it from opposite ends of this long base line to find its distance Even so the angle of convergence is so small—but a fraction of a second of arc—that the most refined instrumental means, and one precaution after another, are required to obtain trustworthy results. If a star is within a hundred light years —which counts as a fairly small distance—two or three observations with great modern telescopes will give us a very good idea of its distance—though the problem is like that of determining the distance of a light house fifty miles away by sighting upon it from two points two inches apart

But the large majority of the stars—even of those visible to the unaided eye—are much further off than this, so that we must find some other way to measure their distances if we are to determine them at all

Fortunately the astronomer has many strings to his bow When we cannot get individual results we can often find a reliable average value This we do by taking advantage of the sun's motion through space among the other stars If only the sun was moving and all the others stood still all would be easy The stars straight ahead of us—close to the point in the sky toward which the earth and sun are moving—would seem to stand still So would those directly behind us near the opposite point All the others would appear to drift backward from the first point toward the second at a rate which for stars at the same distance would be greatest half way between the "apex' and "antapex and would diminish gradually toward both Of stars at different distances the remoter ones would seem to move more slowly

Observing with the spectroscope which reveals the rate at which the stars are approaching or receding from us we would find all the stars near the apex approaching, those near the antapex receding and those half way between doing neither one nor the other The speed at which the sun was moving would then be found and it would be a simple matter to calculate the distance of any given star from its observed rate of drift

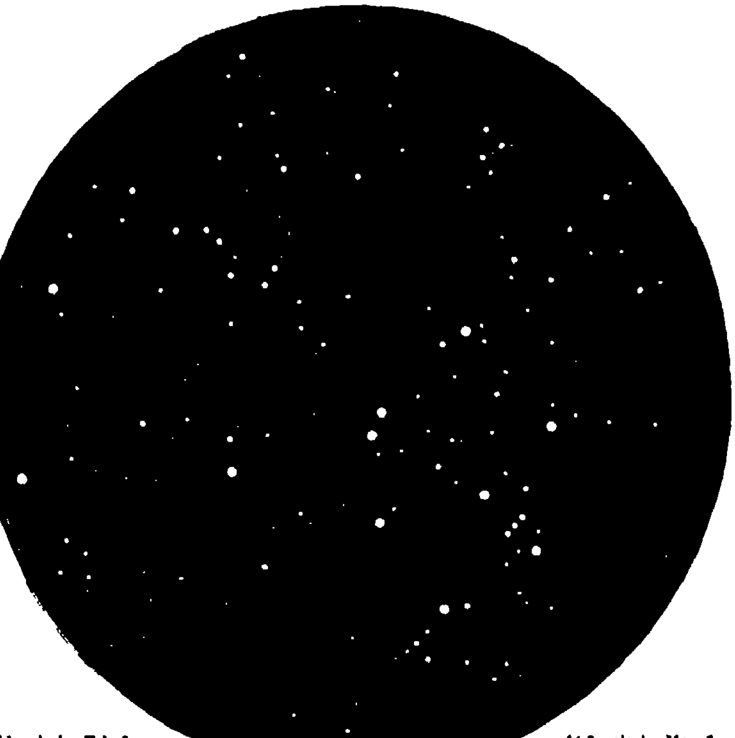
Actually things are far more complex than this, for the stars are all moving, as well as the sun—some in one direction and some in others some fast and some slowly For an individual star this motion may double or treble the drift due to the sun's motion or may diminish or even reverse it But if we take a considerable number of stars in the same part of the sky and average their motions these individual or 'peculiar motions will trouble us little for being as likely to be one way as another they will average out' and almost disappear from the mean value while the drift due to the sun's motion, being always in the same direction comes out to its full amount when the average is taken

We can thus get the average drift and thus the average distance, for all the stars we have considered (Strictly speaking, this 'average' distance is not quite an ordinary average but it is at least *representative*, representing a star whose motion is the average of the whole) When our stars are not confined to a small region but are scattered all over the sky a similar method, with slightly more complicated algebra leads to an equally good average value

If our stars are moving slowly so that most of their apparent motion arises from the sun's motion and little from that of the stars themselves this method gives very good values But for rapidly moving stars, whose own motions are much faster than the sun's, we can not trust the averaging-out process The remaining uncompensated effect though but a small fraction of the motion of an individual star may be a large fraction of the solar drift, and our results are thus vitiated

Averages, Probabilities, and Star Motions

But we have still another string to our bow Consider the part of each star's motion in the sky which is at right angles to the direction of the solar drift This is unaffected by the latter and arises only from the motion of the individual stars Take the average amount of this motion (no longer considering plus and minus signs but only the numerical values), and we find how fast the stars seem to move on the average, on account of their own motions This will evidently depend both upon the average speed, in miles per second at which the stars are moving, and on their average distance If we can find the former, we can calculate the latter But our spectroscopic observations which can be corrected, one by one for the solar motion enable us to find this very thing, and so we get another representative average distance



At 11 o clock: Feb 6
At 10½ o clock Feb. 14
At 10 o'clock Feb 21

At 9 o clock: Mar 7
At 8½ o clock: Mar 15
At 8 o clock: Mar 22

At 9½ o clock: March 1

NIGHT SKY: FEBRUARY AND MARCH

We will still need a considerable number of stars to get a good average, for this time we are trusting the numerical values of the rates of motion to 'average up' to the same amount, whether we take motions toward and from us, or crosswise But no *very* large numbers are needed. If we have fifty stars, for example the results of the averaging up process should agree in the two cases, half the time within 10 per cent—which is enough to assure a fairly good conclusion

By such methods as these we may find the average parallax and the representative distance for any group of stars of which we know the apparent proper motions in the heavens, and the spectroscopic velocities (so long, indeed, as we do not pick our stars in such a way that we give preference to those which are moving in some particular way, and so spoil our averaging-out or averaging up) It was in this way that the late Professor Ross showed that the representative distance for five-sixths of the stars visible to the naked eye is about 320 light years and, in similar fashion, it has been shown that the corresponding distance for the stars of the tenth magnitude (even including the nearer ones, which are faint because they are actually small, and which bring down the average) is fully 1000 light-years.

Other Interesting Cases

Dr Wilson, one of Professor Ross' assistants, has recently made in this fashion a very interesting study of the distances and real brightness of the variable stars. Delving patiently into the tabulated records of earlier observations, he has derived the motions of many stars not previously studied, and, with the richer material thus made available, he has obtained excellent average values. Taking first the Cepheid variables—those singular stars which change steadily in brightness, rising to two or three times their original luminosity and falling back again, with exemplary regularity, in periods which range, from different stars, from a few hours to a month—he finds, as Professor Shapley did before him, that the stars of longer period are exceedingly remote, the representative distance for forty stars being 1000 light years. At this distance, the "representative star" of the group would be of magnitude 6 2—just visible to a keen eye, but the corresponding real brightness comes out 250 times that of the sun This is the average brightness, as the star varies it ranges from perhaps 150 to 350 times the sun's light. The stars with periods of about half a day (which form a distinct group) look fainter to us, and are also really fainter, though they are farther off The distance for a typical star of the tenth magnitude, based upon examination of thirteen of them, is 2200 light-years, and the corresponding real brightness averages forty times that of the sun.

These conclusions support those reached some years ago by Professor Shapley, upon which he based his remarkable estimates of the distances of the globular star-clusters They indicate, from much more extensive material, that the great distances which he then derived are *substantially* correct They may, indeed, be slightly too great but probably by less than 20 per cent—which does not alter at all the conclusions derived from them regarding the scale of the universe

More recently Dr Wilson has applied similar methods to the red variable stars, some of which change their brightness irregularly, and by moderate amounts, while others vary by a hundred fold or even more periodically, with a year or so between maxima For these stars, as for those discussed above, the results of the two methods of calculation are in good agreement. For a typical variable star, which at its brightest is of magnitude 7.5, the distance, both for those that vary irregularly and for those that are periodic comes out close to 1000 light years and the real brightness seventy times that of the sun. The irregular variables fluctuate from this brightness to some 30 or 40 times that of the sun, those of long period often drop to less than the sun's luminosity At maximum they are normal giant stars in brightness—like hundreds of others of the same spectral types, so that we may regard them as stars which at intervals become faint, rather than as stars normally faint which at times brighten up

The only exception to this run of average brightness is found among the very old stars, with peculiar spectra, which are known as classes R and N These are much farther off—at distances something like 2500 or 3000 light years, and average perhaps 500 times as bright as the sun, though they seem to differ widely among themselves.

It is from just such data as these that we may hope—not quite yet, but perhaps before long—to get the clue to the physical phenomena which cause the variation in brightness.

The Heavens

The finest part of the sky is now in the southwest, where Orion, Taurus and the Great and Little Dogs blaze in the clear winter air, with Gemini above them, and

(*Continued on page 144*)

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

The rapid-fire vegetable chopper

A New Vegetable Cutter

MINT, parsley and similar vegetables need to be cut fine and they really seems to have been no device provided except the kitchen shears which are not an official kitchen utensil, but are used for many of the handy jobs in the kitchen. Now we have a miniature circular harrow which cuts such vegetables as we have enumerated with great speed and precision. The ten disks are very sharp so that the speed of the operation is considerable. The cutting is, of course, much more uniform than when a pair of shears or a cutting knife is used. The use of such devices as this does away with much of the drudgery of the kitchen.

The Universal Comb Cleaner

CLEANING a comb with a pin is tedious, and if one happens to be a hairdresser it is especially tedious. Why not, then, string a number of threads on rows of nails so that the comb can be run along them and all the spaces cleaned at a single motion? Fine and simple. But here's the rub: getting the proper spacing of the threads to fit the spacing of the comb-teeth is rather difficult, and when you come to think that no two combs commonly have the same number of teeth per inch, then the whole thing is not worth the bother. Into the breach steps a Chicago manufacturer with a simple little device that has the stretched threads all nicely and evenly spaced. On opposite ends of two bows of steel wire are mounted two aluminum castings having rows of little posts across their top. On these posts, back and forth, the threads are strung. All ready to clean your comb—No, the spacings are wrong here, too. Easy: the end castings are pivoted on the bows, move one bow away from you, the other toward you. When the threads are the right distance apart to fit the comb, stop. They are always parallel. There is a proposition in geometry about that, but we are out of school—therefore we have forgotten it. Anyway, the comb cleaner works, and works in a jiffy.

A substitute for the pin for cleaning combs

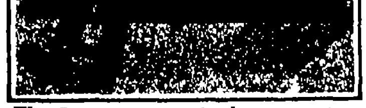
A 10,000-Pound Crane Scale

PRACTICALLY every day industrial progress develops a new use for a weighing device or scale particularly adapted to meet specific requirements. A new scale was developed for the U. S. Government for the purpose of measuring the pull on cables used to hold an airship at its moorings and this scale was immediately adapted for the measuring of unusual, heavy loads on cranes or booms where weights or loads up to 10,000 pounds are handled, assuring that the safe working load is not exceeded, and thus eliminating dangerous overloading and disastrous accidents.

The scale is of steel construction. Its accurate action depends upon four extremely heavy springs. The dial is 15 inches in diameter.

Another Automatic Wrench

ANOTHER "revolutionary" idea in wrenches, if we are to credit the modest claims of the inventor, is that illustrated herewith. As the picture indicates, the tool is another version of the wrench that takes hold instantly and automatically without any preliminary adjustment. Like the Stillson wrench, it will only work in one direction, this direction being that in which the handle in the position pictured, is rotated upward. This brings into play the double linkage and the spring tightening the jaws on the work. If rotated the other way, the wrench, like any Stillson, will open and slide off the work; but when used correctly, it possesses a bull-dog grip, effective at any angle, and with no tendency to slip no matter how hard one pulls.



The January entry in the automatic wrench sweepstakes

Paper Saws to Cut Veneer Wood

CIRCULAR saws are made of paper for use in making veneer and fine furniture, and are turned out in a factory in England. Thin plates of wood cut by these saws are so finely finished that cabinet makers do not have to plane them at all before they are used. Such saws were originally shown at an English exposition and were driven by an electric motor. They are manufactured from a special type of compressed drawing paper.

Indeed, compacted paper of such hardness has been made in England that it has even been utilized in place of building stone. Experiments in the manufacture of car wheels from compressed paper have been made in the United States for a number of years, but the product has never competed seriously with the ordinary steel wheels. It is only in the production of certain articles as the veneer saws that any advantage is found.

The "Transinductor"

WE illustrate a new transforming apparatus, designed by Ernest W. Kersten of Menominee, Mich., which has been very successfully applied in tuned radio- as well as tuned audio-frequency amplification. This principle has also been adapted to transmitting sets in the oscillatory circuit. There are two types of radio-frequency amplifying transformers: The air-core type, and that with the iron core. Anyone wishing to receive a particular wave length could receive with satisfaction with the air core type, but he was limited as to wave lengths or frequencies to which he could tune in. That difficulty could be overcome by using an iron core, but in so doing amplification was sacrificed. In either case one met with frequent disappointment.

It follows that the ideal transformer should combine air-core amplification

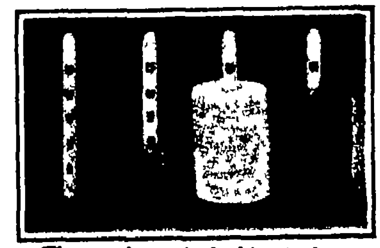
A more effective type of radio transformer

with iron-core tuning range. That has been accomplished in the "transinductor." In this new instrument the action is similar to that of two transformers, the primary and secondary of each being connected in series. The primaries and secondaries being split between rotor and stator, and iron being introduced into the rotor, we obtain through a range of 360 degrees (no two positions being alike) control of inductance capacity and iron giving high amplification on all wavelengths from 150 to 750 meters.

A Diesel-Driven Motor Car Ferry for Canada

THE great increase of motor traffic to and from Vancouver Island was the cause of the building of a special motor car ferry which has capacity for 45 motor cars and their passengers. In several ways the design of this unique vessel is exceptional. Cars are carried on both lower and upper deck and to make the former accessible a ramp was installed amidships which will enable cars to climb to it under their own power. This ferry which was built at Victoria, B. C., has a length of 170 feet, a breadth of 42 feet and draws 11 feet of water. The hull is of wood.

The propelling machinery consists of two sets of six-cylinder four stroke-cycle 600-brake-horsepower marine Diesel engines, which on trial tests gave the ferry a speed of $14\frac{1}{2}$ knots per hour. In addition to the accommodations for 45 cars there is a comfortable dining saloon with a maple dance floor so that the passengers can plan their itinerary with a view to dining and dancing while crossing to the island. The ferry is provided with electric lighting, hot and cold water, and heating devices. In general appearance she resembles an ordinary steamer more than a ferry in spite of the necessity of designing her for a maximum deckload capacity.



The mathematical chip-stacker

Invention and the Saturday Night Card-Game

INVENTION has removed one of the petty annoyances that beset the poker player. No longer need he wonder how many chips he has, or how he stands on the banker's record; no longer need the superstitious player be annoyed by his neighbor's fingering of his stock to see how far ahead of the game he is; no longer need the banker strike an elaborate trial balance to insure that no extraneous chips are being foisted off on him at cashing-in time; no longer need the chips that were lost on the floor or placed forgotten, in the pocket of the heavy winner embarrass the business of balancing the game at the breaking-up hour. For the latest chips have a hole in the middle and are guaranteed all of uniform thickness. Each player has a little tray, with posts for the reds, the whites and the blues, and the accurate marks on these posts, combined with the uniform thickness of the chips themselves, enables every player to know at every moment exactly how many of the "seeds" are stacked in front of him. Incidentally, the perils of the collapse of a lofty stack are also minimized by the new style of banking. Complete sets of chips, posts and storage box, in every style known to the fastidious poker player, are offered by a leading manufacturer. Incidentally, the back of the box carries a simple peg and hole counter by which the banker may score up the chips which he issues to each player, thus doing away with another fruitful source of argument.

A Wire Vegetable Washer

WASHING spinach is a laborious undertaking, and requires the changing of water many times to remove the dirt and sand. Indeed this vegetable is rarely served fresh in hotels, as it takes up so much time of the

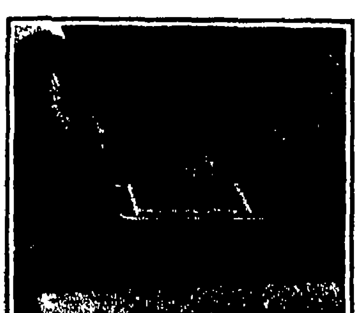
Washing spinach without changing the water

Invention takes the scrubbing pail in hand, with the result pictured

pantry man With the device illustrated the drudgery of washing spinach lettuce and other vegetables is reduced to a minimum The basket is constructed entirely of wire and opens to permit the vegetables being enclosed The two handles are grasped with one hand and the basket is placed under a faucet which soon cleans the vegetable in a thorough manner This is a valuable addition to the kitchen outfit

The Thermostatic Solder-Pot

SOLDER must be kept at uniform temperature if satisfactory results are to be obtained When overheated it oxidizes and there is a notable loss of material and of tensile strength by what remains A solder pot has been designed to prevent this by means of automatic temperature control The principle used is a modification of that found in the steam gage A volatile substance very sensitive to heat actuates a Bourden tube which makes and breaks the electric current, thus controlling the temperature of the contents of the pot Ordinarily the apparatus is so made up that this control goes into play at 600 degrees Fahrenheit The pot will hold fifteen pounds of solder and will heat this right up to the dead line temperature in twenty or twenty five minutes This action quick for an electric heater is obtained through the working of a 900-watt heating element built around the entire container Heat is applied to all parts of the side and bottom of the pot Once the container is filled and the current turned on no further attention to the pot is necessary The current is automatically broken when the heat reaches 600 degrees and reestablished when it sinks materially below this figure Workmen may thus devote their entire time to production without losing any time watching the pot that never boils The pot weighs but thirteen pounds and works from 110 or 220 volts alternating or direct current hence it is very largely portable.



French fried potatoes without a struggle

My Lady's Scrubbing Pail

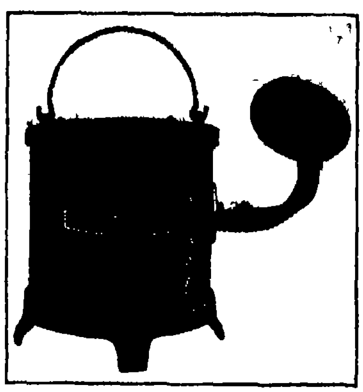
THIS might be described as a pail with a college education, for it will do nothing wrong as will the ordinary pail It is neat and orderly, will not tip over, will not drip on the carpet, will carry soap, brush and cleaning cloths carefully segregated The pail comes in attractive shades, so as to take away much of the drabness of scrubbing which is the meanest form of housework The pail is made extra heavy so that it is not likely to tip over The pail is securely fastened to a flaring pan which serves to catch any drip and also affords space to tuck in cleaning rags A regular soap container and a place for the scrubbing brush complete the outfit

A Novel Strainer

OFTEN vegetables such as Brussels sprouts or mealy potatoes are broken in the process of straining as this operation is usually done with a separate utensil With the strainer we illustrate the danger of breaking the vegetable is reduced to a minimum and the cooked article, be it vegetable soup or stew, can be strained and the remaining food after the liquid is poured off may be put back on the fire in the original vessel to keep warm A strainer of this kind has more uses in the kitchen than we can enumerate The semi circle of tin is punched with holes so that the liquid will run through The outer edges are well reinforced so that the utensil will last a long time

A French-Fried-Potato Machine

FRENCH fried potatoes are deservedly popular but are usually served in hotels and restaurants rather than in the home The reason for this is that there is considerable art in cutting potatoes into the long strips with square or rectangular section With the aid of a special cutter like the one we show, there is no difficulty in producing a per-



The solder pot that will not burn its contents

fectly formed slice ready for the hot fat A heavy wire frame holds together a sharp tin grid adapted to divide the potato vertically into sections Various patterns are provided so that any size may be produced The peeled potato has the bottom cut off so that there is a flat surface in order that it will not wobble when the cutter is forced down through it The cutter is seized with both hands and is forced slowly and firmly through the potato until stopped by the cutting board Like so many of these ingenious kitchen appliances it will save its cost in a short time It comes from France

A Boiler With 1200-Pound Steam Pressure

A BOILER capable of producing 1200 pounds steam pressure said to be the highest steam pressure it has ever been attempted to put to practical use, will be installed in a huge power station now being constructed at Weymouth, Mass., for the Edison Electric Illuminating Company of Boston

Although generating this tremendous pressure, the boiler will have a heating surface no larger than that of the 375-pound pressure boiler commonly used to generate steam to drive turbines in large power-houses The heating surface of 375-pound boilers is approximately 20 000 square feet

The steam output of the high-pressure boiler will be more than 110 000 pounds per hour In many respects its construction will be similar to that of any other boiler of lower pressure The tubes or pipes in which the steam is heated over the firepot will be no larger in bore than those ordinarily used but will be somewhat thicker in order to withstand more pressure The drum or covering in which the tubes will be incased however will be a hollow steel forging with walls four inches thick and thereby capable of withstanding extremely high pressure

A strainer for use with any pot or kettle

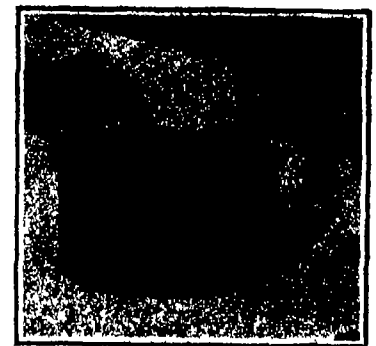
From the tubes or pipes in the boiler the steam will pass into a superheater made of another series of pipes and placed between two groups of regular tubes in such a way that they are surrounded by terrific heat and a steam pressure up to twelve hundred pounds is generated

Whereas the steam generated in the customary 375-pound power house boiler is discharged into a single turbine, the steam from this high pressure boiler will go through two turbines being twice expanded and used instead of once It will first pass through a special turbine capable of taking the 1200 pounds pressure Then it will be brought back to 375 pounds pressure by passing through another series of pipes in the boiler—this series is known as a 'reheater'—and go into an ordinary turbine designed for operation in the ordinary way under that pressure

Without employing the "reheating plan used in this boiler, the most advantageous steam pressure both practically and economically, according to noted steam engineers is about 375 pounds Larger pressures have been experimented with heretofore in various countries but were found impracticable because of technical reasons, for the increase in pressure did not bring a corresponding increase in the amount of electricity generated by the turbine into which the steam passed

However when the steam is passed through two turbines, as is the case with this boiler, the high pressure is practicable

The engineers who worked out the plans for the high-pressure boiler calculate that it will produce with 13 600 tons of coal the same amount of power produced by a 375-pound pressure boiler with 15 100 tons of coal a saving that will aggregate many thousands of tons in the course of a year If the boiler proves a success—and the engineers have great faith in its ability to do so—several similar ones will be installed in the power house



Popping corn the easy way

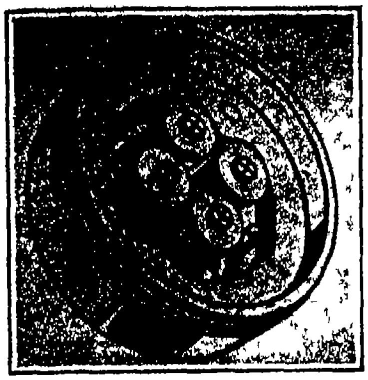
The Rotary Corn-Popper

AMONG the pleasing household novelties offered this season is the corn popper illustrated herewith The customary shaking of the old-fashioned popper is replaced by a rotary motion of the handle, which is easier on the user and more effective This popper will work on gas, kerosene or wood stoves. The operation of the popper is so satisfactory that over 800 were made and sold privately in the inventors' home town before it was put on the market commercially The secret of good popcorn is claimed to lie in the action of the paddle a member shaped somewhat like a propeller blade, and attached horizontally to the inner end of the vertical shaft, half way between the top and bottom of the container Rotation of the handle rotates this, and keeps the corn in constant motion

A Three-Color Signal Lantern

THERE are often places where a visible signal giving information by colors is useful We find at railroad stations white, red and green lanterns all carefully trimmed and awaiting an emergency There are other places where a safer if less robust light is required A safe lantern to use around a garage or where there is gas or inflammable vapors is very desirable and we have received such a lantern from a concern in Colorado There is no iron or steel used in the construction so there is no danger of a spark The rubber-covered handle is secured to a canister which carries a large dry battery connected through the medium of three switches shown to the left with three small incandescent lamp bulbs showing red, white and green These can be flashed on singly or all may be turned on at will enabling various combinations of signals to be displayed A heavy wire frame protects the delicate bulbs

Three-way signal lantern that carries its own battery



Internal arrangement of the four-spool headphone

Four-Pole Headphones

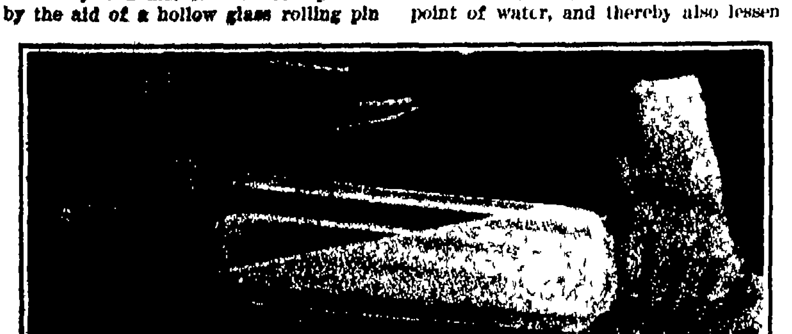
THE true index of power of an electromagnetic device depends upon the number of ampere turns embodied in the windings. It is therefore evident that, by using a round four pole construction instead of the standard two-pole rectangular cross section, almost twice the number of turns may be got into a radiophone in practically the same space while equal ohmic resistance is retained. In addition, there will be a more uniform magnetic distribution on the diaphragm. The windings of the four pole phone developed in accordance with this argument are of the spool type. This, with the fabric insulation in the bottom of the case is claimed to make grounding of the case or coils impossible so that this phone will stand a higher voltage than any other instrument. The claims are also advanced that this phone is especially sensitive to the weakest signals, that it gives true tonal reproduction under varying conditions, that tube noises and strays are almost entirely eliminated, and that the phone stands the highest amplification without distortion of sound while operating at highest efficiency.

Portable Electric Bench-Lathe

ENTIRELY self contained and portable, with motor built into the head-stock, the lathe illustrated herewith requires only an electric outlet somewhere in the vicinity to make it possible to set it up and use it anywhere. It is claimed to be unusually accurate and to handle work with exceptional rapidity. It clears five inches over the tool rest and seven inches on the face plate while between centers any adjustment up to twenty four inches is available. The equipment includes the motor two tool rests of six and twelve inches respectively head wheel face plate and cord of good length for attachment to any lamp socket. For serious work making the demand of portability as well as for the use of the handy man about the house, it seems that this little lathe ought to fill a large place.

A Refrigerated Rolling Pin

IN making fancy pastry it is often necessary to have the crust very thin and flaky and this can be accomplished by the aid of a hollow glass rolling pin which is filled with ice water. A metal cap at one end of a handle permits the rolling pin to be filled with ice water. The use of such a pin will help the baker of toothsome dainties, such as "Napoleons" and other pastry specialties. A glass or porcelain rolling pin is far more sanitary than the old maple rolling pin.

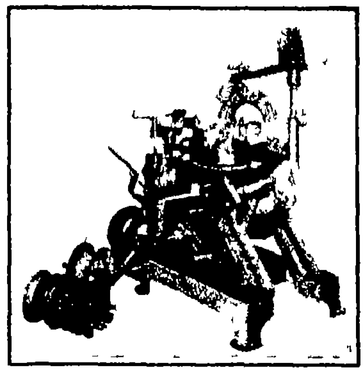


The rolling pin that does not stick to the pastry

Machine for Wrapping Coils of Wire

A MACHINE that wraps coils of bare or insulated wire with paper has been developed by a Chicago manufacturer. The machine is motor driven by gear and pinion. Drums or sheaves revolve at the proper speed so that the coil is advanced while the shuttle applies the wrapping. The shuttle is driven by a belt and the drums are adjustable to accommodate various sized rolls. These drums also move upward and downward by means of a crank so as to properly center the coil.

In wrapping with paper the exposed edge is turned under a quarter inch so as to give strength where it is needed the most. This is done by an edge-folder through which the paper passes before it is applied to the coil. So that a tight wrap may be obtained the shuttle is equipped with a tension device through which the paper passes and this offers resistance to the paper as it is applied drawing it as tightly as possible without breaking.



Wrapping wire coils by machinery

Honey-Water as a Non-Freezing Engine-Cooler

DURING last winter practical automobilists and truck drivers in five different States made careful tests with a simple mixture of honey and water used as a cooling medium in the automobile engine, and, without exception pronounced it superior to the alcohol and other non freezing solutions they had tried. The tests reported were made in Illinois, Ohio, New York, Vermont,

Lathe that can be set up wherever there is current

and Wisconsin all of which States have severe winter weather.

The honey water generally used—a half and half mixture—does not boil until a temperature of 220 degrees Fahrenheit is reached thereby ensuring a cooling by conductivity instead of by radiation for eight degrees above the boiling point of water, and thereby also lessening evaporation. The boiling point of the alcohol mixture is below that of water.

When the honey water is boiled, only the water evaporates the honey remaining behind unaffected. The percentage of honey in the solution remaining is thereby increased and the freezing point is correspondingly lowered. The contrary is true of the alcohol solution the alcohol evaporates before the water does and the freezing point of the remainder is raised. And since the honey does not evaporate little if any need be added after the cooling system of the car is first filled at the beginning of the winter season the only care being that of keeping the system supplied with water as often as it is needed. The alcohol mixture must be tested occasionally and more alcohol supplied to make up for loss by evaporation.

An estimate may be easily made of the cost of the honey required for a radiator of known capacity. It is only necessary to know the capacity in gallons and to allow one gallon of honey for each two gallons of radiator capacity if a half and half solution is to be used. This gives a mixture a trifle richer in honey than in water as honey weighs about 12 pounds to the gallon. The present price of good extracted table-honey varies considerably in different localities probably ranging from 10 to 15 cents a pound in bulk however the cheaper grades serve in the automobile as well as the best. But whatever grade is used should be well ripened that is it should have been left with the bees until they have had time to thicken it well during which time certain enzymes will have changed its sugar content from sucrose to invert sugar therefore thin or fermenting honey should not be used.

A complete union of the honey and water is said to be essential. And since they do not unite readily when cold the desired result can best be attained by first heating the water and then stirring the honey into it after which it should be boiled for several minutes. If straining is necessary nothing is better for the purpose than a piece of wet flannel.

Illinois experiments showed that equal proportions of honey and water united by boiling formed a mixture that did not lose its fluidity until a temperature of two degrees below zero Fahrenheit was reached at which point it assumed a mushy condition and that a solution containing 60 per cent of honey did not freeze at 12 degrees below.

The fish scraper that prevents the scales from flying

The Safety-First Fish-Scaler

EVERY housewife has had the sad experience of scraping scales off a fish only to have them fly all over the premises. This will not happen to the up to date lady of the kitchen equipped with the fish scraper illustrated. The knife is so designed that instead of flying off at a tangent the scales can only roll quietly out under the knife and play dead on the table. The teeth are blunt so that they do not cut the flesh of the fish but they are claimed to take off the scales like magic, in half the time required with more ordinary means.

Grafting Cotton on Mulberry Roots

A MULBERRY tree with cotton grafted on its roots at La Marque Texas is growing and renewing growth each year as if it were part of the tree.

This unusual feat in plant grafting has been performed by P. Dan George, a farmer of foreign birth. Dr E. P. Humbert of the Texas Agricultural and Mechanical College confirms the statement that there is a real union between the cotton plant and the tree. This connection has been maintained for two and a half years and this year the grafted cotton plant yielded nearly a thousand bolls of cotton—a yield many times greater than that of an ordinary cotton plant.

The grafted cotton plant having been converted into a perennial puts out new growth from the crown each year. During the winter the plants are protected by a covering from the cold. Nothing was noted by Dr Humbert that indicated that the cotton was undergoing any marked change because of its union with the mulberry root. Difficulty has been experienced in getting the seed of the plants to germinate only two seed having reproduced.

A Gigantic Tea Ball for Cooking Rice

ANYONE who has ever cooked rice remembers what difficulty is experienced in keeping the rice from sticking to the pot and the grains sometimes even burn. To obviate such troubles a manufacturer has conceived the idea of cooking rice in a gigantic tea ball which cooks the rice perfectly without the grains roaming around the pot. When

Borrowing an idea from the tea ball for cooking rice

The electric heater that sets up convection as well as radiation

the rice is cooked the ball is opened and if the quantity was correct there will be a perfect rice ball all ready to serve with a curry or with Chinese sauce. The size of the ball is so large that it really seems like a *Gargantuan tea ball*. It is a very useful addition to the kitchen equipment.

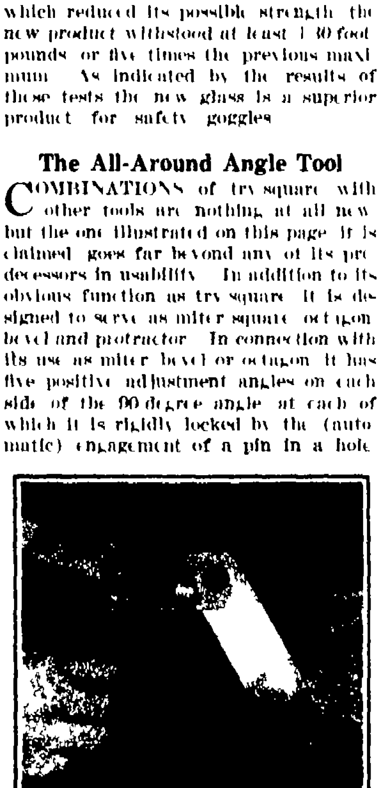
Shock-Proof Glass

AN American optical instrument company which during the world war threw off the foreign dominance of the *optical glass industry* has announced that in its own glass furnaces it has obtained a product that withstands great shocks and blows and which is recommended for goggle lenses. This glass is as thin and transparent as usual lenses.

The Bureau of Standards in Washington recently completed comparative tests which show *that it is far superior* to preceding types of goggle glass. Samples of the new material successfully withstood blows of 2.95 foot pounds produced by dropping a steel ball 1 1/8 inches in diameter from a height of eight feet. In all cases even when finished in ways which reduced its possible strength the *new product withstood at least 1.80 foot* pounds or five times the previous maximum. As indicated by the results of these tests the new glass is a superior product for safety goggles.

The All-Around Angle Tool

COMBINATIONS of try square with other tools are nothing at all new but the one illustrated on this page it is claimed goes far beyond any of its predecessors in usability. In addition to its obvious function as try square it is designed to serve as miter square, octagon *bevel and protractor*. In connection with its use as miter bevel or octagon it has five positive adjustment angles on each side of the 90-degree angle at each of which it is rigidly locked by the (automatic) engagement of a pin in a hole.



The try-square of many uses

On these adjustments the blade stands rigid without the slightest 'waggle', yet it can be instantly released for new adjustment by a slight thumb pressure upon the push button. For carrying the blade may be alined with the handle.

Double Duty from the Electric Heater

SOMETHING new in the application of electricity to heating problems is offered by a New York manufacturer. Instead of relying solely upon radiant or reflected heat which is ineffective so far as raising the room temperature is concerned it employs simultaneously the three principles of radiation conduction and convection. In the first place the *heating element is hollow* like a gas retort with both ends open and copper tubes are attached at top and bottom converting it into an elongated flue which is placed vertically within the body of the apparatus at a suitable distance from the reflector. As the inner walls of the heating element become hot *they super heat the air within this cylinder* and this air is naturally expelled at the top of the tube while cool air is *drawn in at the bottom*. This circulation once set up is continuous. The reflector has been made oval rather than circular for the purpose of accommodating a heat tube of greater length. As a result of all this, there is not merely a blast of radiant heat passing across the room and heating persons, walls etc but there is continuously discharged into the atmosphere of the room by convection a current of heated air while there is considerable ordinary conduction of heat from the copper through the air.

Roads From Clover and Sawdust

IT *is reported that an experiment in* road making in a sandy district in Minnesota has proved successful. This road was constructed by employing a mixture of freshly cut yellow clover and rye straw with the sand base the idea being to convert the sand into a vegetable loam so that it might be worked *into a road*. The highway has been in use for some time and is highly praised by the farmers who use it.

In some portions of the State the sandy nature of the soil makes good roads out of the question without the importation of surface materials. In most cases this is impossible by reason *of the expense*. So there was evolved the idea of changing the character of the soil along the highway by mingling it with vegetable matter. *In one place* clover was used and on a shorter stretch sawdust was employed as the road-making ingredient.

For the clover road the road was graded and planted on the right-of-way was yellow clover and rye except for a driveway of 20 feet. The rye was planted with the clover to protect the latter during the summer. Rye straw was thrown on the road and worked into the sand by passing vehicles. Several times during the summer the clover was cut and also thrown upon the road. This was well worked into the sand and has partly changed the character of the soil, getting away from the difficulties of a sandy road.

Four inches of sawdust from a sawmill was spread over a quarter of a *mile of road* near another place and worked into the sand in a similar manner. The top of the roadway was frequently worked so as to prevent ruts and the sawdust was well mixed with the sand. This is rotting and is gradually making it possible to work the road as if it were made of loam.

Rose Shears

ORDINARY scissors are of course perfectly well adapted to cut flowers although gardening shears of greater strength have been recommended *and sold. If the plant or bush* is high the flower is apt to drop to the ground after the stem is severed. We show two special forms of shears which cut and hold the stem at the same time. In the first one when the blades antagonize, an extra lug on one blade holds the flower until the shears are opened. *In the other the same effect is obtained by means of two springs* which snap against the stem and hold it securely until released.

Flower shears with grippers that seize and hold the severed blossom

Another way of keeping the cut flower from falling to the ground

The Scalp Massage Bottle that Rubs It in

WHEN you purchase a bottle of scalp remedy the directions practically always tell you to rub it into the *scalp*. This advice is excellent, but people do not follow it very long. It is human nature to rub it in for the first few days after which the original enthusiasm wanes and the user compromises by applying the liquid without applying the exercise. This may do some good or it may not. The massaging is very beneficial, probably *accounting* in some cases for fully half of the good results obtained. It loosens the scalp causes the blood to flow through a million capillaries and releases dandruff and scale. How, then, to get people to massage the scalp? A Chicago manufacturer of hair remedies has come forward with a simple solution of this problem. If you can't reform human nature then reform the bottle in which the hair remedy comes. *Make it necessary in order* to get the liquid to flow, to massage the head with a rubber device attached to the bottle. The bottle in question has a large rubber cap from which project several rubber nipples through which the scalp liquid oozes as the scalp is rubbed. If you have no hair, if you have little, or if you have some scalp disease like dandruff or scaliness one minute's rubbing *per day for a month or two* with this remedy will probably produce surprising results. You may then discover a very fine thin crop of fuzz at first observable only under favorable light. Of course if you can get fuzz you ought to be able to get hair, for that is proof enough that the roots of the hair are not *dead but have merely been dormant*.

One of the chief causes of falling hair is the excess of fat secretion from the sebum glands, one of which lies at the root of each hair. This fat, called sebum becomes caked forming little round plugs in the follicle which close so tightly around the base of the hairs that they break off and fall. When a remedy that is beneficial to the scalp is applied daily with the bottle that rubs it in, *these little plugs of hard matter are* loosened the follicle is thus opened and if the stimulating rubbing treatment is persevered in daily you are at least on the road to hair again.

Sometimes the roots of the hair have died. If this is the case there is no hope. But in the majority of cases of baldness *even if there has been no hair* in years the roots still live. In such cases the fuzz will appear generally within *a month or two*, in some cases sooner and the rest depends upon the enthusiasm of the user and whether he massages the scalp with the bottle every morning making it a part of the shaving ritual, or merely does it only once in a while. New hair cannot be easily earned. The manufacturer of these massage bottles sends them out filled with several kinds of liquid, for the treatment of dandruff falling hair scaliness etc. Each condition demands a separate remedy. It is a relief to find a remedy for baldness that does not necessitate one's going about smelling like a tar barrel.

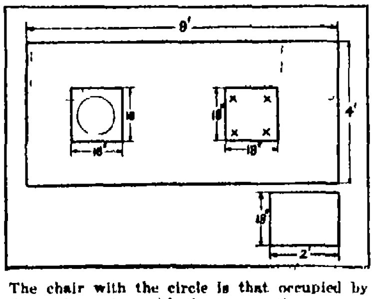
To get the massage fluid to flow from this bottle, the motions of rubbing it in are necessary

Our Psychic Investigation Advances

(*Continued from page 86*)

tion, contributing added certainty that he had enough freedom of chest and shoulders to get the right arm out of the glove and sleeve The left arm obviously, unless something were broken or untied would have to work from *statu quo* and through the glove in any contribution it might make to the action of the seance

Thus secured, the medium was placed in the cabinet, at the right (*i e, his right as he faced the sitters*) At the left, and some 4 feet distant was another chair with tambourine, trumpet, whistle and two bells Outside, at the left and touching the curtain stood a small deal table Palladino came with unusual promptness the doctor had difficulty with her hoarse whisper but finally gathered that she wanted the medium in the corner He and I therefore entered the cabinet and placed both chairs more closely into their corners as indicated in the diagram on this page Palladino then spoke in better voice and made clear her desires in accordance with these, we moved the medium to *the left side of the cabinet* and placed the other chair at his right, half a yard or so from him This meant that the apparatus was on the same side as his potentially free hand and that both it and the table were much nearer to Nino than at first The second diagram makes all this clear

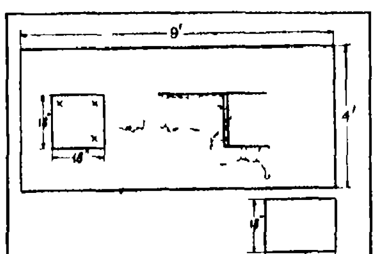


The chair with the circle is that occupied by the medium that with the crosses the one containing the apparatus The full squares indicate the original positions of the chairs the dotted ones their places after the first rearrangement

Early condition of the cabinet at the initial seance

For 24 minutes after this we had nothing but conversation *with repeated demands that we talk among ourselves* Then the physical phenomena commenced with raps After quite a display of these we had a nine minute hiatus with talk and scraping of the chairs in the cabinet then the bells came into play and rang very freely The trumpet was next used to tilt the table to stroke the curtains and finally for a short bark of inarticulate voice The tambourine and both bells operated simultaneously being followed by a very finished act in which they and the trumpet four in all were used in succession at short and uniform intervals The whistle came into play last, very loud and shrill

This brilliant phase lasted 12 minutes, being followed by 15 minutes in which there came from the cabinet only demands that we talk and sing While responding to the latter request we got a fresh shower of raps, bells and tambourine in time with the song A further wait of ten minutes was terminated by a crash in the cabinet with distressed cries for aid We found the chair with Nino in it *capsized on its side* and in going over he had struck his head on the other chair so that his nose was bleeding freely We righted him and found him in such hysteria that it seemed imperative to cut him loose without delay



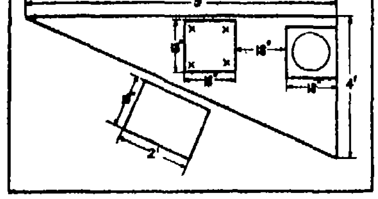
The position in which the two chairs were found at the end of the first sitting, with the medium prostrate

Superficially I was able to examine the bonds as we cut them they seemed little disturbed with one important exception The wire about the forearms had been anchored to the upper arms At the left this anchorage had not been tampered with on the right it had been loosened and slipped down to the elbow Perhaps this was accidental but I judged that until the wire was thus eased, the arm could not be sufficiently straightened to be withdrawn from the sleeve

Both bells showed finger prints no teeth marks were found on any of the apparatus

On the 14th we paid less attention to the wire about the forearms, concentrating upon so arranging the ropes about the arms and chest as to assure a minimum of mobility of the shoulders* We sewed the left glove to the coat sleeve and the right to the shirt, and put the apparatus at Nino's right Recalling the first seance, a request *for transposition* might have been expected, but it did not occur

The cabinet was only five feet wide this time, by special request of Dr Vecchio It was covered across the top, at a height of six feet I ought perhaps to explain that "cabinet" is a technical term of the seance room, it denotes, not an article of furniture, but merely an enclosed space at one side or corner of the room Ours is made by pinning black cloth over a sectional wooden framework



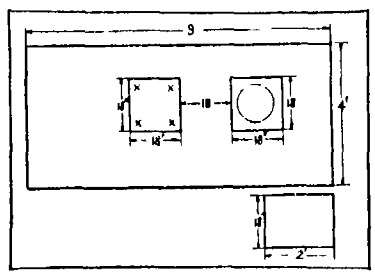
The way the triangular cabinet was set up for the third seance

The initial period of inactivity was this time 20 minutes It was less occupied with conversation from Palladino and there was less creaking of the chair A demand was made that three of the sitters who were quite close to the cabinet be withdrawn to a greater distance When the demonstrations began they occurred to a considerable extent upon the table outside the cabinet there was never enough light to furnish observations of value here however

At one time a bell was placed upon the table and fell to the floor outside the cabinet I replaced it on the table, and it was later taken back into the cabinet The tambourine was placed *on the* table and covered with the trumpet The table itself tilted sharply and repeatedly and was turned about and left at an angle with its original position In other details the sitting was substantially a repetition of the first one

Dr Vecchio was positive that he saw a hand outside the cabinet One or two others were inclined to verify this in part though unable to identify the object as a hand Dr Block thought it a shadow passing over the cloth Most of us saw nothing

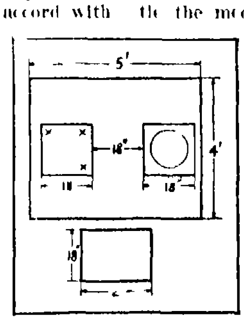
At Nino's informal sittings it is customary to get hand clapping On Monday and Friday Dr Vecchio asked for this repeatedly sometimes setting the example with his own hands At no time was the request honored though everything else that he asked for was given In view of the known improbability *that both of* Nino's hands could be normally free this omission seemed significant



The final arrangement at the first seance which prevailed throughout the active phase

The violent phase of the second sitting lasted for 20 minutes with slight interruptions It was succeeded by a period of inactivity during which we got nothing save Palladino's voice After 61 minutes of this she finally permitted the sitting to end in accord with Dr Vecchio's reiterated demand But first she called him to the cabinet and whispered to him that the medium had been very restless and that we should find his bonds seriously disturbed

This was putting it mildly as the photographs indicate The wire about the forearms had been so *displaced that all* the loops save one were now about the right wrist alone The one loop which had resisted this treatment remained to act as a pivot, about which the arms could play like scissors giving a wide range of movement for both gloved hands



The arrangement of the smaller cabinet for the second sitting

The most desperate *attempts had been* made to free a hand Mr Hopkins had to take his overcoat to the tailor next day to have the left cuff repaired where it had been chewed as though by a teething puppy At the right the coat sleeve had been drawn back and the undershirt similarly chewed where it joined the glove Both gloves were saturated with saliva In both gloves the lining which was separate from the outer shell had been turned partly inside out similarly with the thumbs and it had been found impossible to return Nino's thumbs to their stalls The conclusion from all this that it had been impossible to free a hand was borne out by the failure of any of the apparatus to show finger prints The performance if *not genuinely psychic had been engineered* with gloved hands brought into play by hitching the chair from point to point in the cabinet

For the third sitting we planned something not yet tried—a definite attempt to fix the medium so that he could effect no escape whatever in normal fashion We made this attempt under the best of auspices Houdini *interrupted a vaudeville tour and came on from Little* Rock Ark to superintend the tying

For the disposition of the hands we used the gloves again but sewed them both to the undershirt Then we forced each sleeve down over the other hand and sewed the two sleeves firmly together The linings of the gloves had been sewed to the outer layers at the tip and the thumbs tacked down against the bodies The coat was a suit coat rather than an overcoat and the gloved hands packed the sleeves so tightly that Nino could plainly get no action with his hands unless he burst the sleeves The coat was sewed snugly about the neck and at the two front corners and in the middle of the back was basted to the trousers

With the soft rope supplied him Houdini personally tied Nino into the chair and he did a masterly job In every case he made a loop about the arm leg chest etc and tied this with a square knot leaving ends long enough to form a second loop to pass about the appropriate portion of the chair Drawing the former loop only so tight as was comfortable for Nino and the latter as tight as it could be drawn a maximum of security was ob*tained without hurting Nino* in the least—unless he was going to struggle to free himself in which event he could make himself acutely uncomfortable

The medium's chair was tied to the base board of the cabinet with a loop of metal strap a cord and a wax seal The chair could not be displaced without breaking the seal and this could not possibly be done by accident *Securing the chair in this fashion* made it unnecessary to discommode Nino by fastening his feet clear of the floor as would have been necessary otherwise for with his feet on the floor and the chair free he can move the chair anywhere he pleases

The chairful of apparatus was placed in front of the medium and 20 inches distant We sat for 81 minutes *and with the exception noted below nothing oc*curred save conversation from Palladino She wanted us to talk and sing as usual Now she praised the skill with which we had tied the medium and again she complained that he was very uncomfortable Houdini resented this and I had to restrain him from arguing it with her Later he did argue it with Dr Vecchio insisting *that so long as no attempt was made* to get free the bonds were as comfortable as bonds could reasonably be I agreed with him If we cannot tie the medium effectively without stopping the phenomena let us have this understood once for all

Throughout this sitting the cabinet gave off intermittently sounds like those from a chair that stands unevenly tilting back and forth from three legs to another three Sometimes this was accompanied by slight disturbances of tambourine or bells identifying the affected chair as the one carrying the apparatus

When we entered the cabinet at the end we found that the second chair had been placed in contact with the baseboard at the back of the cabinet, and that Nino's *foot could be twisted into contact with* this same baseboard We demonstrated experimentally that a noiseless application of the foot to the board would rock the chair and duplicate the noise we had heard and we observed marks on the board indicating that the foot had been applied to it Even Dr Vecchio accepted this explanation, and agreed *that nothing supernormal had* been heard

Examination showed conclusively that the medium had attained no freedom though sounds from the cabinet indicated attempts to do so Houdini had not underestimated the difficulty of tying a strong and active human he had said that he wouldn't guarantee that Nino couldn't get loose but he would guarantee that he would never get back He had not got out at any point, however and there had been so physical

(*Continued on page 133*)

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

GARMENT FASTENER.—R. A. Nowak, 940 So. Bixel St., Los Angeles, Cal. The particular object of this invention is to provide a device that will dispense with the button and buttonhole now commonly used for *garment fastening.* A further object is to provide a fastener that can be cheaply constructed, and very easily operated. (See Fig. 1.)

Electrical Devices

ELECTRIC MOTOR DRIVEN COMPRESSOR.—G. J. Stohrer, 46 L. Eppirt St., East Orange, N. J. This invention is largely used for tire pumping and makes a distinct development in that it attains a high speed in a compressor. It is constructed to run over 2000 revolutions per minute. One important factor in attaining the high speed, is the absence of bearings on the compressor, the piston thrust being on the bearings of the high speed motor; this permits of a high speed drive connection usually direct between the motor shaft and the compressor piston.

AUTOMATIC BATTERY WATER SUPPLYING DEVICE.—A. Menger, 611 Adams St., San Antonio, Texas. The invention relates to a device which is adapted to be applied to electric storage batteries of ordinary types such as are adapted for use in automobiles, to automatically maintain the electrolyte in the several cells of a battery to which applied at a desirable level by supplying distilled water to the cells when required. The device may be operatively applied without preventing the inspection or testing of the electrolyte. (See Fig. 2.)

STORAGE BATTERY FILLER.—C. Burkhard, 728 Elton Ave., Bronx, N. Y. The general object of the invention is the provision of a simple portable filler which may be used to fill any container with a fluid which will conduct electricity, or to dilute any conducting fluid, the filling means being provided with means for automatically shutting off the filling device when the fluid in the container has reached a certain level.

Of Interest to Farmers

CUTTER FOR FORAGE AND GRAIN GRINDERS.—J. Hochenauer, c/o Hochenauer Alfalfa Mills Mfg. Co., Pueblo, Colo. The invention relates to that type of apparatus in which a series of cutters are disposed at various angles upon a lengthwise shaft for operation above a semicylindrical screen. An object is to produce a cutter formed of a flat strip of metal with concavely curved sides whereby cutting edges are formed at opposite sides of square ends whereby the number of cutting edges may be materially increased and the cutting materially enhanced.

POULTRY PERCH.—J. Manchester, North Loup, Neb. The invention has for its object the provision of a device adapted to contain a medicated solution which will saturate the perch to prevent mites or other vermin from infesting and propagating on the perch. A further object is to provide a longitudinal groove extending from end to end of the bar, such groove being covered so that the disinfecting solution will not come in contact with the feet of the poultry.

BRUSH GRUBBER AND LEVELLER.—E. C. Leak, Susanville, Calif. Among the objects of this invention is to provide a simple, easily constructed economical device of the character specified, wherein an A frame is provided adapted to be drawn through the sage brush, and provided with cutting blades on its inclined side for cutting and pulling up the brush.

MOWER.—C. Lorenson, c/o Lorenson Harvester Co., 1314 W. 3d St., Davenport, Iowa. An object of this invention is to increase the mobility of the machine and to enable it to be used where the cutter bar is required to work at various angles relative to the general position of the machine so as to enable the machine to effectively cut grass or vegetation where the slope of the ground passed over by the cutter bar, is generally unfavorable for cutting, the machine may also be adjusted for topping weeds or the like.

MANURE REMOVER AND SPREADER.—H. C. Wright and W. J. Wright, Dugold, Manitoba, Canada. Among the objects of the invention is to provide a device of the character specified equipped with mechanism for loading manure and also for spreading, and feeding the same to the spreader, the traction wheels automatically operating the feeding mechanism. A further object is to provide means for throwing the traction wheels and feeding mechanism out of gear without spreading manure.

SPRAYER.—J. C. Frederick, 1902 Fullerton Ave., Detroit, Mich. The invention relates to agricultural implements. The primary object is to provide a sprayer constructed in the form of an attachment which may be easily attached to and detached from the frame of a cultivator so that the sprayer may find ready use in connection with the cultivation of plants, or the sprayer may be used separately from the cultivator, or other farm tool.

GRAIN SAVER.—C. F. Kiuth, Wibaux, Mont. The invention has for its object to provide an attachment or grain saver for self binding grain binders and other harvesting machines. A further object is to provide in combination with the platform canvas or apron, or endless conveyer and elevator canvas, a grain saving attachment so as to catch all grain that falls between the platform and the elevator canvases and onto the ground.

FRUIT CATCHER AND GRADER.—J. F. Cook, 846 Brunswick St., San Francisco, Cal. This invention relates to the harvesting of fruit such as apples, prunes, apricots, peaches and the like which require careful handling. The principal object is to facilitate the gathering in an economical way without making it necessary for the fruit picker to climb the tree. The catcher is portable and is associated with a grader, the fruit being gathered and graded simultaneously. (See Fig. 3.)

THRASHING DEVICE.—H. R. Tucker, Box 414, Balboa, Canal Zone. This invention relates to a device for thrashing rice, wheat or other grains, its general object is to provide a manually operated device that may be set up in any convenient place, such as on a table, for example, it is designed primarily for use in isolated situations in lieu of the primitive flail. (See Fig. 4.)

Of General Interest

DISPLAY TABLE.—W. Patten, 57 W. 125th St., New York, N. Y. An object of the invention is the provision of means whereby the periods of rotation and rest of the table can be varied at will so that when the articles of merchandise are displayed and mounted on the table their peculiar intermittent motion causes the attention of the public to be drawn more quickly to them.

DISPENSING DEVICE.—S. S. Celano, 889 2nd Ave., New York, N. Y. The invention relates to a brush such as is primarily intended for use in connection with the brushing of the teeth. It is an object to provide a brush with which a tube of tooth paste may be operatively combined to permit of the substance contained within the tube being applied directly to the bristles of the brush. It is a further object to provide a self-contained and compact device of this character.

CAMPING OUTFIT.—O. E. Hans, Box 202, Paden, Okla. An object of the invention is to provide a camping outfit which is of simplified construction and which will afford sleeping and housing accommodation for a plurality of persons when set up. The device is adapted to be attached to an automobile of ordinary construction in such manner as not to retard the movements of the car, and may be folded into small compass whereby it is readily portable when detached.

TABLE FOR TALKING MACHINE.—J. F. Borst and W. Borst, 1117 Cypress Ave., Ridgewood, Brooklyn, N. Y. It is the primary object of the invention to insulate the diaphragm from friction, vibration and sounds from the sound box and stylus and various metal parts of the machine, by the use of a material the transmission qualities of which are extremely low, thereby leaving the diaphragm free to render a clear reproduction.

CONTRACTED OR SHORTENED CHARACTERS FOR PRINT.—E. R. Santoni, 11 Via del Comune, Ancona, Italy. The object of this invention is to provide contracted characters for print, the main feature of which comprises a fundamental letter, symbolized secondary letters inserted in the same, and symbolized mobile overhead letters superposed to the same, the secondary letters being in a reduced shape.

BRACELET.—W. Segman, 102 Fulton St., New York, N. Y. This invention more particularly relates to a chain bracelet and has for its general object to provide a chain bracelet which aims to embody strength combined with an attractive appearance yet embodying links of simple form well adapted for receiving stones in a desirable arrangement, the bracelet being composed of elliptical links and intermediate shorter links.

BOOKBINDING.—G. S. Fry, c/o Gregg Publishing Co., 585 5th Ave., New York, N. Y. Among the objects of the invention is to provide means whereby the strain between the boards of the cover and the back of the book is eliminated, the cover being hinged to

5.—WHAT IS INVENTION?

INVENTION is difficult of definition, it is almost always a question of fact. An improvement may or may not be invention, if to devise such an improvement *the exercise of the true inventive faculty is required,* it is an invention. But the border line between pure invention and the practice of mechanical skill, technical knowledge and experience is often indeed vague. Perhaps the best judicial expression respecting the foregoing is that of Justice Bradley of the Supreme Court, delivered in 1882 as follows: "The *process of development in manufactures creates a constant demand for new* appliances, which the skill of ordinary head workmen and engineers is generally adequate to devise, and which, indeed, are the natural and proper outgrowth of such development. Each step forward prepares the way for the next, and each is usually taken by spontaneous trials and attempts in a hundred *different* places. *To grant to a single party a monopoly of every* slight advance made, except where the exercise of invention somewhat above ordinary mechanical or engineering skill is distinctly shown, is unjust in principle and injurious in its consequences. The design of the patent laws is to reward those who make some substantial discovery or invention which adds to our knowledge and makes a step in advance in the useful arts. Such inventors are worthy of all favor. It is never the object of those laws to grant a monopoly for every trifling device, every shadow of a shade of an idea which would naturally and spontaneously occur to any skilled mechanic or operator in the ordinary progress of manufactures. Such an indiscriminate creation of exclusive privileges tends rather to obstruct than to stimulate invention. It creates a class of speculative schemers who make it their business to watch the advancing wave of improvement, and gather its foam in the form of patented monopolies, which enable them to lay a heavy tax upon the industry of the country without contributing anything to the real advancement of the arts. *It embarrasses the honest pursuit of business with* fears and apprehensions of concealed liens and unknown liabilities to lawsuits and vexatious accountings for profits made in good faith."

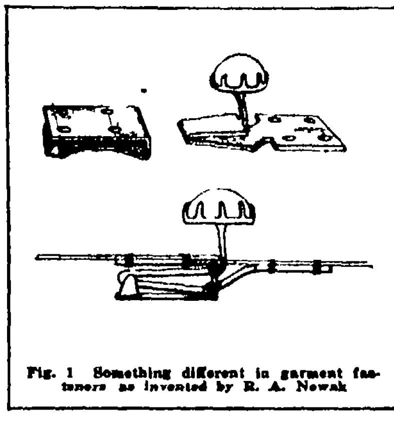


Fig. 1. Something different in garment fasteners as invented by R. A. Nowak

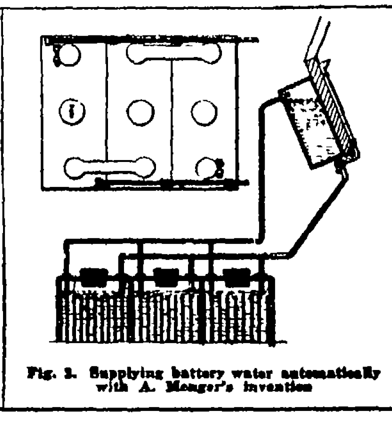


Fig. 2. Supplying battery water automatically with A. Menger's invention

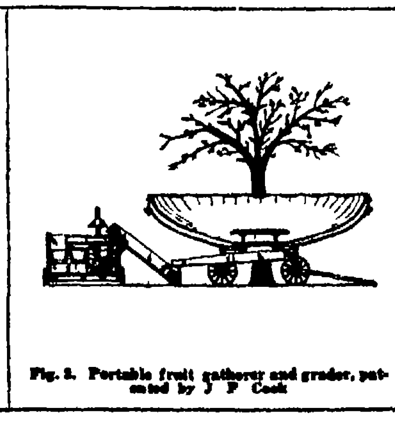


Fig. 3. Portable fruit gatherer and grader, patented by J. F. Cook

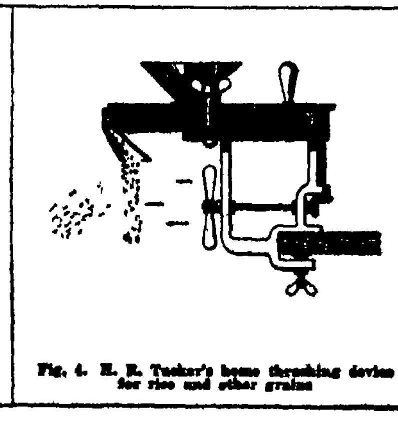


Fig. 4. H. R. Tucker's home thrashing device for rice and other grains

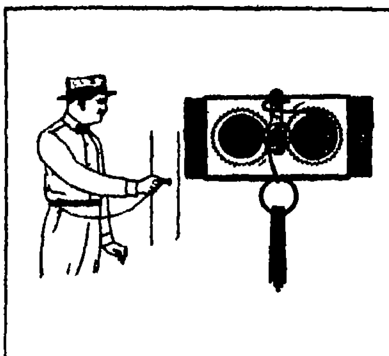


Fig. 5. T J Morrison's key holder with extensible chain and reel

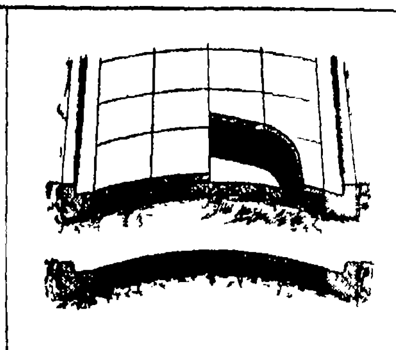


Fig 6. J B. Watts' new design for road surface, facilitating expansion

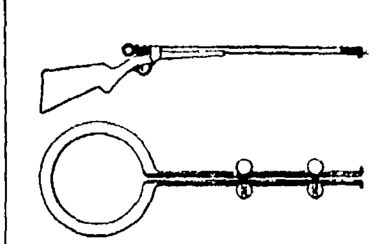


Fig 7 Combined stop and handle for bore-cleaning rods, the invention of E H Williams

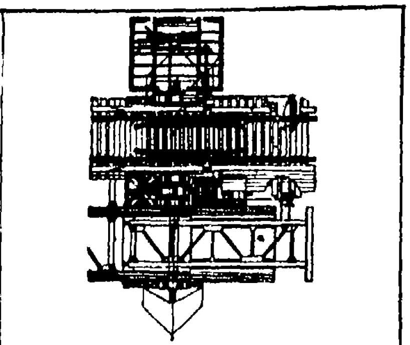


Fig 8. Novel bridge structure of portable type patented by S. A Roake

permit of its being swung completely around beneath the body portion and lie adjacent the other cover portion without any strain what ever on the parts.

KEY CHAIN REEL—T J MORRISON 367 W 123d St., New York, N Y The general object of the invention is the provision of a compact reel provided with an extensible means for holding keys or the like, that operates to retain the extensible key holding means in its extended position, and that may be operated to draw the extensible key holding means into the casing (See Fig 5)

CONTAINER.—A H TRAGESER and L HASSINGER, c/o Albert H Trageser, 447 W 26th St., New York, N Y The primary object of the invention is to provide a shipping container particularly adapted for the transportation of heavy fluids such as paint, ink, varnish, and the like, the device being provided with a removable closure plate so constructed that a liquid tight joint is had between the container and the closure plate.

ARTIFICIAL BAIT—P E PETERSEN, c/o Frank Leveroni, 814 Fremont Bldg, Boston, Mass. The invention relates to an artificial bait made to simulate a minnow and is equipped with gang hooks and a plate projecting at the under side The general object is to provide a plate so formed and arranged as to develop the utmost rotary or turning motion of the bait about its axis to produce a rapid wiggling motion approximating the actual motions of a life fish in swimming

EXERCISING DEVICE—C G PURDY, 151 Linden Ave, Brooklyn N Y The invention is especially designed and constructed for exercising the teeth and gums The primary object is to provide a device the use of which will supply the necessary exercise to the muscles of these several organs to keep the organs in a healthy state and operate as a preventive agent and curative medicine in cases of pyorrhea.

PROCESS FOR PRODUCING STEEL —J T JONES, 2032 Greenup St., Covington, Ky The primary object is to provide a process by means of which a cheap deoxidising and recarburising agent may be used to obtain a product of the highest grade tool, or armor plate, steel A further object is to provide a process whereby iron of a fibrous nature, such as wrought iron, may be treated so that the surface may be rendered extremely hard, the hardness decreasing toward the center The process comprises treating the surface with material comprising molten pig iron containing carbon in a combined state

ARTIFICIAL BAIT—G E. FENNER, c/o J E. Wall, Oxford, Wis. This invention relates to a fishing bait in which the hooks are ordinarily guarded and the barbs thereof covered to prevent the bait from catching on weeds, but in which the hooks become automatically exposed to hook into the fish, upon the bait being taken by the fish the device including means that will instantly return the hook to protected position without action by the fisherman.

MOTHPROOF CHEST—W C DEISS, c/o J C Roeser, 156 Broadway, New York, N Y The invention has for its object to provide a device in which clothing or other articles may be conveniently stored and which may be closed as to effectively prevent the entrance of moths, or which may be treated in such a manner as to be repugnant to moths. The device is strong and durable, and may be collapsed for the purpose of storage or transportation.

LINE FASTENER.—H C. LAFFERTY Box 156, New Castle, Pa This invention relates to means for fastening a clothesline guy rope, or the like, and more particularly to a fastening device of the hook type having means for suspending it in position and for so engaging the rope as to hold it fast but permit of the rope being readily loosened with the greatest facility when desired A further object is to provide a line fastener that may be either hung on a fixed hook or applied as a connection between terminals

PEEP SIGHT FOR FIREARMS—I C MATTHEWS, Kamiah Idaho An important object is to provide a peep sight which may be rotatably adjusted for accuracy in aiming when firing at different distances A further object is to provide a sight which may be attached to any firearm without changing the construction of the same The device consists of but few parts, yet is efficient in operation

FORM FOR CONCRETE CONSTRUCTION—C W HAYWARD 920 E Gutierrez, Santa Barbara Cal The aim of this invention is to provide a device which will require very little lumber and time for its setting and which will furnish a form for continuously constructing a concrete wall whether hollow or solid and in which the wall may be progressively advanced in height by the repeated application of the given number of boards throughout various stages of the building of the wall

HAND BAG—I C BLUMENTHAL 62 W 115th St New York N Y This invention has for an object to provide a construction which is very simple but which will act as a proper enclosure while presenting a locking and supporting means A further object is to provide a hand bag with supporting and locking straps arranged to pass beneath the lower edge of the bag and to a point above the bag so as to support the bag and its contents at the same time lock the upper part of bag

COUPLING—F G JOHNSON c/o Stuart Johnson Co Hibbing Minnesota Among the objects of the invention is the provision of a device for easily and rapidly attaching a hose to a fire plug whereby firemen will not lose any time in getting their equipment ready The attachment is capable of being locked against manipulation by unauthorized persons A further object is to provide cooperating members which may be automatically connected and sealed to prevent loss of water

BUILDING BLOCK—G FY 307 F 87th St New York N Y The general object of this invention is the provision of a simple and durable block so designed that when subjected to a breaking strain, the line of break is long in comparison to the dimensions of the block A further object is the provision of a block in which the web and bracing members joining the side walls terminate in a plane extending at right angles to the side walls so that the line defining the junction of the ends of the bracing members and web with the side walls is straight.

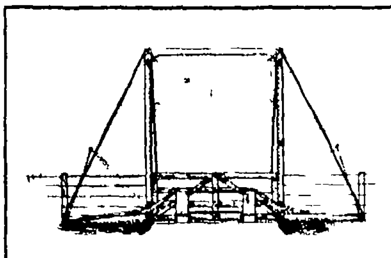


Fig 9 G H Knutson's self-closing gate operated by the weight of the passing vehicle

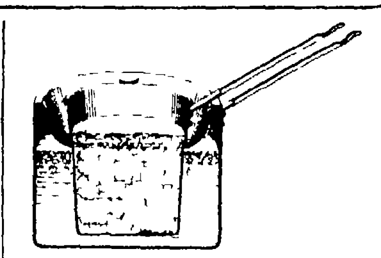


Fig 10. A better double boiler designed by J R. Smith

CLASP FOR BRACELETS—K L TOELCKE, A MIKKOLA and L SHAPIRO c/o Master Jewelry Co 57 E Jackson Blvd Chicago, Ill An object of the invention is to provide a clasp for a bracelet or the like that securely locks the free ends of the bracelet against unintentional separation from one another The device is constructed to resemble the ordinary link of the bracelet and therefore not contrasted against the general design Means are provided for releasing the lock but it is not likely to become accidentally actuated

OPTICAL BINOCULAR INSTRUMENT—E. WESSELY and J SCHIER c/o Paget Moeller Hardy, Vienna, Austria The object of this invention is to provide a binocular official instrument for inspecting narrow cavities which is simple and cheap in construction, which can be readily cleaned and sterilised and in which the rays of light coming from the object to be inspected enter the two eyes of the observer at an angle of divergency greater than that at which they come from the object

KNOCKDOWN TABLE.—W SCHWARZLER, 1462 Edgewater Ave, Chicago Ill An object of this invention is to provide a knock down table which may be readily assembled and disassembled without the use of tools or the like, and when disassembled may be packed in a relatively small space A further object is to provide a table in which the legs can be secured so as to produce a light, strong and durable structure, not likely to easily get out of order

TANK CONSTRUCTION—S DIGGLY R F D No 3 Hempstead N Y The invention aims to provide a construction which materially increases the pressure load resistance which reduces the areas of the plate members and segregates the same, which relieves the walls or sides from the roof load stresses which facilitates the process of welding the elements together and which effects an economy both in materials and labor, while at the same time increasing the efficiency of the structure

LIGHTNING ROD—M CREIGHTON Rensselaer Falls N Y The invention has for its general object to provide features which constitute a connector between the point element of the lightning rod and the conductor cable, as well as means to secure the point element in position on a roof or the like in a manner to sustain the connection and cable raised and amply protected against the ingress of rain with the possible result of affecting the electrical connection, due to freezing

SOAP DISPENSER—L S ROSENBERGER, Fox Chase Philadelphia Pa The object is to provide a construction which may be readily mounted in a horizontal plane and in such a manner as to discharge the soap at a desired point, intermittently A further object is to provide a device in which the soap is propelled and forced toward the opening thereby insuring a sufficient discharge to answer the requirements of the operator

DEVICE FOR USE IN MENDING FILMS—R G WYMAN, 424 Dahill Road, Kensington, Brooklyn N Y This invention relates to a device for use in mending motion picture films its general object is to provide a device whereby the film may be scraped at the ends to be jointed and conveniently prepared for receiving an adhesive material for the joinder of the ends, and means to dispose the film ends overlapped for pasting the same and insuring the correct register of the side openings in the respective ends.

HAIR NET—C R PIEPER c/o Iron Products Corp 516 S Second St. La Crosse Wis An object of this invention is to provide a process of manufacturing a spherical shaped hair net by means of a plastic material such as cellulose, which is passed through a molding device having a flat or curved surface A further object is to provide a hair net which may be made of a cellulose material and colored to match various shades of hair The device is free from any unsanitary conditions.

ROAD CONSTRUCTION—J B WATTS c/o Watts Construction Co Concordia Kan The invention has for its object to provide a construction wherein there is provided means for permitting the top of the roadway to respond to temperature changes in expansion and contraction and to permit the surface to be repaired or renewed without affecting the foundation or base of the roadway (See Fig 6)

COMBINED STOP AND HANDLE FOR BORE CLEANING RODS—E H WILLIAMS, Florin Rd Florin Cal The invention has particular reference to a cleaning rod for gun barrel bores The principal object is to provide a simple member for longitudinally adjustable association with a cleaning rod to constitute a stop for engagement with one end of the barrel to limit the movement of the cleaning rod and prevent the entire projection of the end of the rod from the barrel (See Fig 7)

BRIDGE CONSTRUCTION — S A ROAKE c/o Southern Pacific Railway Co, 165 Broadway New York N Y The primary object of this invention is the provision of a movable bridge and more particularly a bascule bridge which may be manufactured at a main plant and subsequently shipped to the point at which it is to be erected the parts being so arranged and constructed as to eliminate any necessity of a supplemental assemblage plant, at the point of ultimate assemblage (See Fig 8)

SELF CLOSING GATE—G H KNUTSON R F D No 6 Pelican Rapids Minn An important object of this invention is to provide an automatic gate whereby the same is elevated by the weight of a vehicle when on either of a pair of runways at opposite sides of the gate A further object is to provide means whereby the gate may be lowered when the vehicle has passed beneath the same (See Fig 9)

DOUBLE BOILER—J R SMITH 920 Waverly St. Palo Alto Cal The invention has for its object the provision of a boiler so constructed that the maximum amount of surface of the inner container is subjected to the direct action of and contact with the boiling water Another object resides in the provision of means whereby in the ebullition of the water due to the steam bubbles splashing the water out of the boiler is effectively prevented (See Fig 10)

HIGHWAY SIGNAL—W V BERGEN and A C SHUTE c/o Niterday Signal Co,

Hillsboro Ore Among the objects of the invention is to provide a device adapted to be permanently arranged along highways for indicating danger or need for caution where in a visual signal is provided capable of being seen either by daylight or at night and having means for illuminating the same through the reflection of projected rays of the headlight of an approaching automobile to render the same visible at night

Hardware and Tools

WELDING TORCH—W J Frank, 2304 W Fayette St Baltimore, Md One of the objects of the invention is to provide a welding torch of simple and light construction which will permit the use of a plurality of tips selectively, whereby the torch can be readily adapted by tip selection for use in welding operations ordinarily requiring the employment of a welding torch designed for either heavy or light work according to the particular service requirements

GAGE—L A Francis Marshalltown, Iowa This invention relates to a gage for measuring cylindrical bores and comprises a plurality of blades having rounded ends to conform to the rounded walls of various bores to be measured and having indications relating to the diameter of each bore a common pivot upon which all the blades are mounted and a cage in which the blades may be housed

VALVE GAGE PULLER.—J L Cunningham and M D Whalen c/o W L Baker Atty Cresco Iowa The object of the invention is to provide a device of the above character by which the valve gage of the type employed for overhead valves in internal combustion engines may be lifted or pulled in an expeditious manner and without injury It is also an object that the device be simple in construction and inexpensive to manufacture

HINGE—F W Muhlenbruch 20 Church St Bergenfield N J The invention pertains more particularly to hinges especially adapted for use on freight car doors The primary objects are to so construct a hinge that in instances where it is especially difficult to open the car door the hinges may be removed without mutilation of the door or car, and may be easily replaced

GARDEN TOOL—W J Kessel 59 Garret St Paterson N J An object of this invention is to provide a tool which is primarily intended for weeding and which can be used either for pulling cutting or digging out weeds The tool is simple and practical in construction strong and durable light in weight and comparatively inexpensive to manufacture

COMBINATION RULE SQUARE, AND LEVEL—R. E McGowan and F W McCorry Box 81 Chanute Kans The general object of this invention is to provide a sectional tool having means whereby the sections are adapted to be disposed in longitudinal alinement to constitute a rule or at right angles to each other to constitute a square, and one of the sections constituting a level

WRENCH FOR AUTOMOBILE PARTS—F B Parker Robinson Kan The general object of this invention is to embody in a unitary wrench device a means adapted to variously engage the parts to be turned such as the cap of a gasoline tank, the radiator tank and the oil petcock for testing as to the oil in the crank-case (See Fig 11)

SAFETY BUTT HOOK—V D White, Cottage Grove Ore Among the objects of this invention is to construct a safety hook which is simple and strong and durable and highly efficient for use in logging mining and like operations the device including no detachable elements such as nuts and bolts, but which includes means carried by the body for closing or opening the space between the bill point and body proper of the hook (See Fig 12)

Heating and Lighting

SUPER REFLEX OIL GAS HEATER—O R Aikman Salem Ill The invention is more particularly directed to a stove adapted for cooking or heating or for a combination of both of these functions and in which kerosene or gas is employed as a fuel An object is to provide a fire box adapted to become incandescent under the action of a flame with means for returning the heated gas at predetermined points with in its circulation through the stove to the hottest portion in order to obtain the greatest efficiency

SMOKELESS HEATER—C H Rutherford and C Townsend Box 726 Jerome Ariz The principal object of the invention is to provide an orchard heater that will emit practically no smoke The device comprises a fire box having a conical top with a central opening a smoke chamber mounted thereabove to receive the smoke means for dripping water into the chamber creating steam in the same to absorb the smoke and a draft means for guiding the products of combustion outward

GAS AND LIQUID FUEL BURNER AND IN THE PROCESS OF BURNING GAS AND LIQUID FUEL—C F Curry and K E Lyman c/o F L Loveless New England Bldg, Topeka Kan The invention relates to burners providing for the convert ing of liquid fuel supplied under pressure into vapor or gas for mixing the vapor with air and for burning the mixture to supply heat for any purpose The general objects are to produce a simple compact light and durable burner that is capable of producing a heat that is intense, and capable of fluctuating both slowly and quickly from the most extreme heat down to almost a mere pilot light.

ACETYLENE GAS GENERATOR—R. W Miller, Means Ky The object of the invention is to provide a simple strong and durable apparatus by means of which gas may be continuously generated uniform in quantity pressure and quality A further object is to provide means for the feed and control of carbide, and automatic means to regulate this feed as well as to clean the gas

BURNER—E F Cornwell and J H McCready Okmulgee Okla This invention has for its object to provide a gas burner tip which is adapted to effect thorough and intimate commingling of a hydro-carbon fuel and air admitted thereto at one end and passing therethrough to the other end of the tip The tip is strong and durable and capable of withstanding an intense heat

FIREPLACE CONSTRUCTION—L B Williams 107 Agnes St Hattiesburg, Mississippi More particularly the invention relates to open fireplaces such as are installed in dwellings. An object is to provide means for regulating the draft and to permit the use of fuels of various descriptions, and means operable at will to convert the device from a closed to an open fireplace or vice versa. (See Fig 13)

FUEL SAVER—A Burdick, 23 Dartmouth St Pittsfield Mass. The invention relates to auxiliary draft attachments for furnaces the object is to provide a simple structure that may be applied to the furnace door to admit a supplemental supply of air above the fire for the purpose of securing more complete combustion of the gases rising from the fire (See Fig 14)

Machines and Mechanical Devices

PHOTO ENLARGING MACHINE—R D Gray, Midland Park N J Among the objects of the invention is to provide an enlarging machine which will enable the operator seated in front of the machine to conveniently reach the various parts and to quickly position the printing paper on the printing frame and locate the latter in proper relation to an optical projector permitting the operator to make a number of enlargements in a comparatively short time

EXPRESSION DEVICE FOR PLAYER PIANOS O F Wall, Box 3048, Honolulu, Territory of Hawaii This invention has for its object the provision of a tone control arrangement in which there will be minimum loss of vacuum both in the several adjusted portions as well as during the movement of parts from one position to an other A further object is the provision of an expression device in which there is an automatically controlled movement of the parts bringing about either slowly or speedily increasing volume as desired

PNEUMATIC CONTROL DEVICE FOR PLAYER PIANOS—O E Wall, Box 3048, Honolulu Territory of Hawaii The invention relates more particularly to the various mechanical or pneumatic features of pianos The invention aims to overcome the necessity of either slots or closely spaced apertures both of which materially weaken a note sheet and a further object is to do away with this disadvantage by an arrangement which will be simple and inexpensive A still further object is the provision of an arrangement in which by the simple addition of a single tracker board opening various pneumatic control devices may be actuated

MOWING MACHINE ATTACHMENT—E F Kranz Kirley S D The invention particularly relates to an attachment commonly known as a dropper An object is to provide a means of controlling the delivery of hay from the dropper and a means which may be readily operated by the driver of the mower A still further object is to provide a dropping mechanism which is strong and durable in use and suitable for various forms of mowing machines

WELL DRILLING ATTACHMENT—H R Rowland c/o V D Moody 90 West St New York N Y The general object of the invention is the provision of a durable and simple device which will operate to grip the casing and to retain it in any desired position A further object is the provision of means for centrally spacing the casing in side the lining and means for closing the well in case a gusher is discovered

CALCULATING MACHINE.—W H Berwick, 732 Westcott St., Syracuse, N Y Among the objects of the invention is to provide a machine upon which a number of different amounts may be recorded and a result obtained which will give the minimum number of bills and coins necessary to make up all of the amount A further object is to provide a machine in which each unit of currency is calculated separately and mechanically the necessity of mental calculation being entirely eliminated

VENDING MACHINE.—F F Molloy, 243 Ontario St., Montreal, Canada This invention has for its object the provision of a simply operated machine for the vending of any articles, in which the operation depends upon the insertion of coins and the manipulation of a handle, which cannot be effectively operated unless the proper number of coins have been inserted Another object is to provide means whereby only a predetermined number of articles can be ejected upon the insertion of a defined amount of money

PROCESS OF AND APPARATUS FOR MANUFACTURING ICE.—R. F Lindsay c/o Mrs M E. Brown 3106 Lee St. Dallas Texas The purpose of the invention is the provision of a process and apparatus by means of which pure crystal ice can be made from any water irrespective of the impurities contained in the water It is also a purpose to provide an apparatus which eliminates the use of brine and its attendant disadvantages and which permits of the harvesting of the ice in the daytime and in blocks of different sizes

BRUSH FOR TALKING MACHINES—J F Borst and W Borst 1117 Cypress Ave, Ridgewood Brooklyn N Y The primary object of the invention is to provide a brush capable of attachment to the sound box of a talking machine in such manner that the brush will be resiliently carried in the path of the stylus and remove foreign material therefrom It is a further object to construct a frame for supporting the brush of material which has low qualities for sound transmission

BAILER—A Boynton 1800 San Pedro Ave San Antonio Texas. The invention relates to bailers especially adapted for removing such material as mud and slush from oil or water wells An important object is to provide a bailer having a plurality of material discharge openings in the sides with greater area than the cross sectional area, so that the material may be readily and conveniently discharged A further object is to provide a bailer having means whereby heavy and stiff mud may be thrust out through one side of the bailer by means of a tool, inserted from the opposite side

ATTACHMENT FOR LATHES—D P Fontana, 314 W 19th St New York N Y An object of the invention is to provide an attachment which constitutes a positive means for preventing relative movement between the tool rest support and the work to prevent injury to the operator or spoiling of the work resulting from slippage of the tool rest support More specifically the invention aims to provide a connection between the tool rest support and either the head or tail stock of the lathe for preventing relative movement between the tool rest and the work

DENTAL CASTING MACHINE—S L Jefferies, Gaffney S C This invention has been granted two patents of a similar

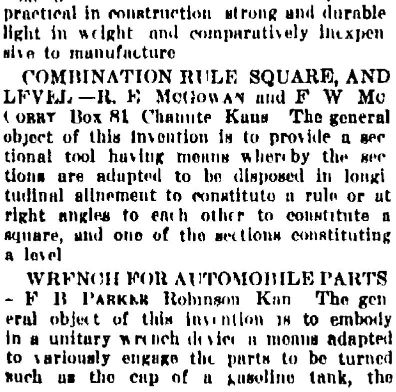


Fig 11 Automobile wrench that is different, the design of F B Parker

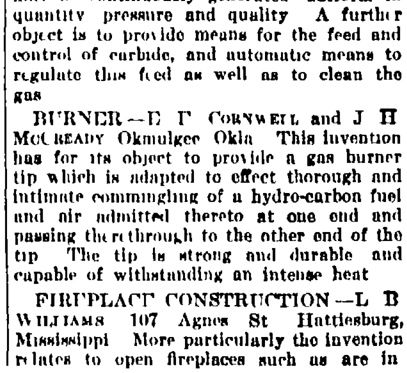


Fig 12. V D White's safety butt hook without detachable parts

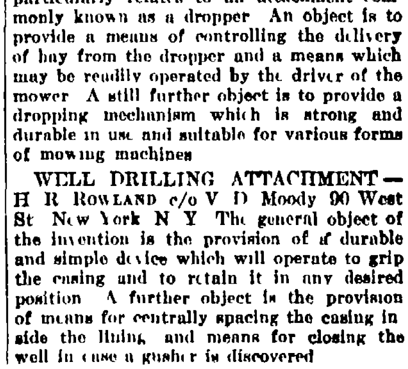


Fig 13. Novel open fireplace construction devised by L. B. Williams

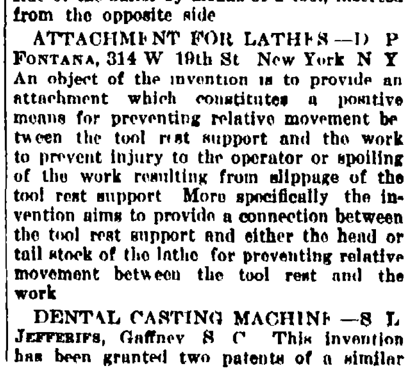


Fig 14 Auxiliary draft attachment for saving furnace fuel, invented by A Burdick

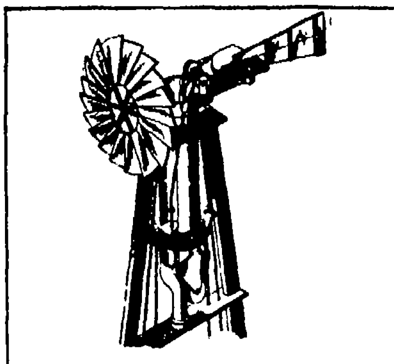


Fig 15. Windmill security is attained by J P Berger's attachment

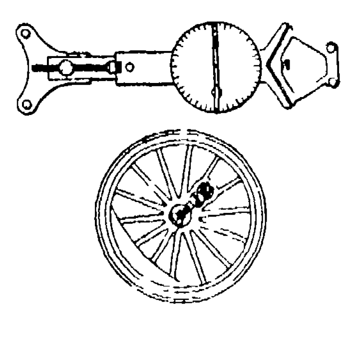


Fig 16. Wheel quartering gage invented by R. R. Royal and D H Brown

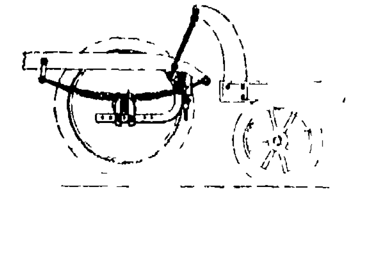


Fig 17 Towing the crippled automobile with H M Holt's invention

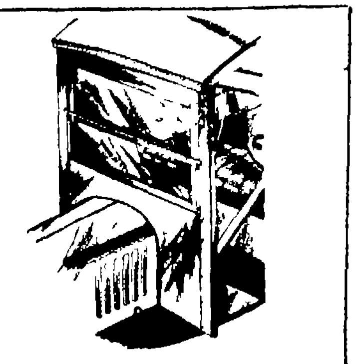


Fig 18. E. H. Bourlier's metal front for automotive bodies

nature their object being to provide a dental casting machine by means of which the fusing of gold porcelain or like material, from which teeth are formed and the casting of a tooth may be accomplished in one operation in a highly expeditious manner It is a further object that the machine be extremely simple in construction and inexpensive to manufacture

SPINNING FRAME AND CAM—J P McCAVITT, 917 Columbia Ave, Millville N J This invention relates particularly to a cam and associated spinning frame the construction being such that the spindles on the frame are adapted to receive an extra large supply of yarn An object is to provide a cam interposed in the driving mechanism of the spinning frame whereby a slow and fast motion may be secured to permit an extra supply of yarn to be wound at a desired point.

OIL PRESS—R S MATHESON, Manila, Philippine Islands The invention has for its object to provide a press of the character mentioned by means of which the material from which the oil is pressed may be fed continuously between moving elements which compress the same to express the oil and which finally deliver the pomace at the opposite end of the machine

APPARATUS FOR CLEARING IN TERMEDIATE FIELD CHUTES—I MEINECKE c/o Calton Mill Co Paia Maui, Territory of Hawaii An object of the invention is to provide an intermediate chute to be disposed between adjacent mills including two inclined portions one of which is hinged at the summit so that it may be tilted for the purpose of clearing the chute The invention is particularly adapted for use in connection with cane sugar mills

PIN—J EVANS, 137 No 8th St Salt Lake City, Utah Among the objects of the invention is to provide a sorting device or pin for materials which may be utilized to advantage in connection with a sorting machine A further object is to provide a pin, the parts of which are normally locked, so that any material associated with these parts will not be accidentally detached but in which these parts will be unlocked in a semi automatic manner upon the pin reaching its final position

GUARD FOR BUFFING WHEELS—G MORGAN 17 River St. Port Dickinson, N Y An object of the invention is to provide a guard for the buffing wheels of shoe machinery and the like which can be conveniently attached to the machine and which will function to prevent scarring of uppers over-counters and back stays of shoes while buffing the heels. A further object is to provide a guard capable of adjustment, and allowing the sandpaper to be replaced

WASHING MACHINE—A F HECHT, c/o General Delivery Worth, Ill Among the objects of the invention is to provide a washing machine which is constructed in such manner that in its operation the water is moved so as to always keep the clothes agitated and to prevent the rolling up of the clothes into wads, the clothes being moved to the sides of the machine then carried upwardly and back to the center

MACHINE FOR CUTTING KEYWAYS—J AITEMAN, 201 W Duncannon St., Philadelphia, Pa The primary object of this invention is to provide a machine tool adapted to be attached to a lathe bed whereby such operations as key way cutting and shaping may be carried out by hand A further object is to provide a combination tool by means of which certain parts may be replaced by other parts to provide a power-operated grinding tool

ICE MAKING APPARATUS—O J MORRIS 82 Ridge Ave Atlanta Ga The invention relates to an ice making apparatus of the stationary ice mold type in which the cakes of ice must be lifted directly from the molds An object is to provide means for filling the ice molds by overflowing connections from one mold to another and purifying the water during the process of freezing by overflowing the impurities

ATTACHMENT FOR WINDING MACHINE—M. LANDI 49 Bond St. Paterson N J The purpose of this invention is to provide an attachment for a silk winding machine which may be applied in numbers one for each of the bobbins employed upon the machine and which is adapted to limit the amount of silk or other thread wound upon the bobbin, that is to say when the bobbin becomes fully wound the attachment will bring the bobbin to a stop and thus discontinue the winding but will not interfere with the normal operation of the machine

PLATING MACHINE—W DIETZEL Merrick L I N Y Among the objects is the provision of a construction which is especially adapted for plating small articles and capable of acting as a pickling machine Another object is to provide a construction utilizing a spiral trough for tumbling articles during the plating so that a continuous operation may be performed and the articles continuously fed in at one end and discharged at the other end completely plated

ATTACHMENT FOR HEMMERS—G T ANT 600 Passaic Ave, Nutley N J An object of the invention is to provide a simple and readily applicable attachment for hemmers whereby the operator can quickly and easily advance the material being hemmed to the hem securing mechanism and without any danger of injuring the fingers The device may be readily applied to and detached from any type of hemming mechanism

WINDMILL ATTACHMENT—J P BERGER Box 474 Uvalde Texas An object of the invention is to provide an attachment embodying means for preventing the cut off chain or cable of a windmill from disengaging the guide pulleys without interfering in any way with the functioning of the cut off chain and pulleys in an ordinary manner The device is simple and is adapted to be applied to a windmill without change to the ordinary construction (See Fig 15)

Medical Devices

SURGICAL APPLIANCE — S A BATES 3101 Miami St St Louis Mo The invention relates to surgical appliances and more particularly to a device for use in connection with surgical operations on the intestines and where such operations necessitate the severing of the intestine An object is the provision of a thimble for maintaining the severed ends of an intestine distended after an operation has been performed

Prime Movers and Their Accessories

AIR FEED DEVICES—E M PERFECT 7007 Cedar Ave Cleveland Ohio This invention relates to an attachment for internal combustion engines which insures a feed of air into the intake manifold in the engine in proportion to the feed of fuel from the carburetor, an object being to provide a device which results in an economy of fuel consumption so that increased mileage may be had from a given quantity of gas, to insure a more perfect combustion and a complete burning of the mixture, and to reduce the formation of carbon to a minimum

INTERNAL COMBUSTION ENGINE—A F VAN AMSTEL Amersfoort Netherlands The invention relates to internal combustion engines of the type wherein the cylinder is in constantly open communication with an auxiliary chamber through a permanently restricted passage The device consists in that a spreader is disposed partly before and partly in the cylinder end of the restricted passage so that the fuel jet which is injected through this passage, into the cylinder on meeting the spreader is broken up into spray and partly evaporated

GAS PRODUCER—D T SMITH, 40 Woodberry Grove Finsbury Park London N 4 Eng The object of this invention is to provide means for performing mechanically some or all of the functions of the producer and especially to provide alternative means in producers for mechanically operating the producer in order that it may be operated independently of the internal combustion engine or the like to which the producer supplies gas

SPARK PLUG—J ANDERSON 1627 Preble St Charleston, Wash The invention has for an object to provide a leak proof spark plug which will have an all metal outer shell or surface and which can be readily assembled and taken apart as occasion may require The space between the core and the body is rendered gas tight by gaskets located at the shoulders of the core and also at the upper end and these parts are clamped together by nuts

ENGINE—A R CARTER Gulfport Mississippi The invention particularly relates to multiple piston steam engines An object is to provide an engine which is adapted to be started by the pressure of steam in any phase of its operation which prevents condensation in the working chambers which possesses flexibility and compactness and other features especially adapting it to fulfill the requirements of an automobile steam engine

Railways and Their Accessories

COUPLING FOR RAILWAY AND LIKE VEHICLES—F A MACKINNON and T HAMPSON c/o Brown & Co 9 Warwick Court Holborn London W C England The invention relates to couplings of the type in which on two vehicles being brought together the shackle of one is automatically guided into engagement with a hook on the other The general principle is to provide a draw hook with a pivoted member having a lower hook adapted to take over a shackle of an adjacent vehicle

WHEEL QUARTERING GAGE—R R ROYAL and D H BROWN McComb Miss This invention relates to gages for quartering the wrist pins of locomotive drive wheels and more particularly relates to attachments for the gages whereby to effectively gage the position of the wheels with the wrist pins accurately quartered or at right angles before permanently driving the wheels onto the axle (See Fig 16)

CAR REPLACING DEVICE — W A HUBBARD 2728 Pacific Ave Hoquiam Wash An object of the invention is to provide a simple and efficient car replacing unit which embodies means whereby it may be releasably and firmly held clamped against a track rail and disconnected from the rail at will for use at another point The device is adapted to be connected in such manner that a stress thereon will tend to prevent displacement or movement of the replacing unit relatively to the rail

SWITCH LOCK—J D MOORE Box 181 Jacksonville Fla The object of the invention is to permit of the release of the lock by virtue of the initial movement of the switch throwing lever and at the same time provide such connections that the switch stand and the switch throwing parts will be so divorced from the switch that the latter will be unaffected by breakage of the switch stand and its support either in whole or in part.

Pertaining to Vehicles

ATTACHMENT FOR WAGON DUMPS—L D MCCULLOUGH and A W BUTCHER, c/o Gravity Dumps Mfg Co Abilene Kan An object is to provide an attachment whereby trucks as well as wagons may be readily dumped A further object is to provide a device of the type described which may be easily attached to a wagon dump of ordinary construction or may be instantly released from the wagon dump

RADIATOR REPAIR COMPOSITION—F PFIMECKY 505 Congress St Austin Texas This invention relates to a composition for introduction within automobile radiators and other metal parts of similar nature for the purpose of closing small leaks especially those difficult to reach by solder the object being the provision of a material which will adhere firmly and closely to metal and will not endanger clogging of the water channels

CONTROLLING MEANS FOR DUMPING BODIES—J H HUTCHINSON, 259 Bridge St Port Melbourne Victoria, Australia Among the objects of the invention is to provide a device employed in connection with load-carrying bodies which will enable the same to be brought to dumping position quickly and easily and will enable the same to be returned to normal position and locked against movement The device may be applied to any conventional type of vehicle

OILING SLEEVE F C FURNAS c/o Shirr Ruffle Co Lima Ohio Among the objects of the invention is to provide an oiling sleeve for semi elliptical and elliptical springs of automobiles and other vehicles the oiling sleeve being so formed that it readily adapts itself to leaf springs with retaining clips thereon, a protecting member and an oiling pad being arranged to receive oil from time to time without the removal of the sleeve

ILLUMINATED LICENSE TAG AND SIGNAL FOR AUTOMOBILES—W R GARNER 400 St Paul Place Box 783 Baltimore Md The foremost object of this invention is to provide a combined automobile license tag and rear end signal the numerals and letters of the former being cut out so that a single lamp on the inside may be made to shine through both the openings and the signal lens the license tag and color screen being replaceable upon expiration of the period for which the tag is issued

AUTOMOBILE TOWING FRAME—H M HOLT 531 W 57th St. New York N Y Among the objects of the invention is the provision of a frame which can be quickly applied to an automobile to engage beneath the springs and the axle and merely by reason of the forces exerted to lift the end, or to tow the vehicle the device being firmly held against the parts with which it is contacting (See Fig 17)

METAL FRONT FOR AUTOMOBILES AND TRUCK BODIES—E H BOURLIER, 912 So 8th St Louisville Ky The general object of the invention in constructing a metal front is to provide one so formed that it will remain a solid unit without danger of distortion and warping as is often the case with wooden fronts the metal front eliminating all danger of rattling or other noises. (See Fig 18)

Of General Interest

MANICURE IMPLEMENT.—J. O. LANDIS, 40 So. Church St., Waynesboro, Pa. Among the objects of this invention is to provide a safe and convenient combined finger nail cutting and cleaning implement, which may be carried in the pocket without injury to itself, the person of the carrier, or other articles that may be contained within the pocket purse or other receptacle, the blade being so mounted that it may be readily moved to either extended or retired position.

CASKET SUPPORT.—J. E. JONES, Lockhart, Texas. The invention relates to supports upon which a casket may rest when placed over a grave previous to the lowering thereof. The object is to provide supports which are extensible and adapted for any width of grave. It is also an object that the supports be so shaped that they will not have any tendency to roll when supporting a casket and also that they be adapted to close into a compact unit for transportation.

CLOTHESPIN.—J. T. PILKINGTON, Vernon, B. C., Canada. The invention aims to provide an extremely simple and inexpensive device of this character which is especially designed for use in connection with pulley lines, whereby the same will function to pass around the grooved pulley upon which the line is mounted. The clothespin being constructed of metal, is practically indestructible.

ROLL FILM FOR CAMERAS.—W. D. HANSEN, 2127 Milwaukee Ave., Chicago, Ill. The invention relates to roll film for a camera of that type having a focusing opening in its rear end, and a purpose of the invention is the provision of a roll film so constructed as to permit of the successive presentation of portions of the film to the focusing opening, and to allow of the focusing of the camera lens through such openings prior to each exposure.

EGG BEATER.—P. J. DIEHL, 124 Standard Ave., Butler, Pa. The invention relates to an egg beater so called and is particularly intended for embodiment in the beaters of cake mixing machines for mixing batter, icing, etc. The general object is to provide means for attaching the beater arms to the head in such a manner that all danger of breaking at this juncture is practically eliminated.

BROOM CLAMP.—I. T. JACOBSON, 631 40th St., Brooklyn, N. Y. Among the objects of the invention is the provision of a simple efficient and durable device which can be readily applied to a broom and as easily removed therefrom to adjustably clamp the fibers or straws so that the broom fibers will be held more or less firmly as desired. The clamp may be adjusted and is provided with latching means.

SELF-CLEANING LAVATORY.—W. T. GUTH, 149 Van Dyke St., Brooklyn, N. Y. This invention has for an object to provide a construction of bowl and flushing means whereby the bowl may be readily cleaned and flushed at the same time. A further object is to provide a self-cleaning lavatory whereby upon the turning of a single spigot water is discharged in several directions and automatically converted into a sheet as it moves into the bowl proper.

CLIP FOR PENS, PENCILS AND THE LIKE.—G. W. CHUMAN, JR., c/o Parker Pen Co., Janesville, Wis. It is the primary object of this invention to increase the strength of a clasp of the above nature and thereby prolong its life. A further object is to so construct the clasp that the rigidity thereof is likewise increased thus causing the clasp to take a firmer grip to retain the article by which it is carried in position.

SHAMPOO CUP.—LILLIAN M. LEA, Bellop Ave., Tottenville, S. I., N. Y. An object is to provide a simple and effective device for holding a supply of shampoo fluid and for affording means to facilitate the application and distribution of the fluid on and over the head to expedite the shampooing operation. A further object contemplates a device which affords a convenient means for mixing the constituent elements of the shampoo agent prior to its application.

LADDER SCAFFOLD BRACKET.—F. T. PETERS, c/o F. T. Peters & Sons, 127 Eastdale Blvd., Springfield, Ill. Among the objects of the invention is to provide a device of the character described which may be quickly and easily attached to the ordinary type of ladder which may be adjusted to support a load in a horizontal plane not withstanding the fact that the ladder supporting the bracket may be at one of various angles from the vertical, the device being held securely by the load supported thereby.

PROCESS OF PRODUCING VERMICULATED WORK.—J. H. DELANEY, 407 S. Hope St., Los Angeles, Cal. The invention relates primarily to building materials such as artificial stone work. The object is to produce vermiculated work upon the surface of plastery materials, which consists in embedding in the surface of the material before the same has set particles of material capable of generating gas in the presence of moisture to thereby produce voids in the surface of the material for the purpose of ornamenting the same and giving the appearance of an antique structure.

BOOKMARK.—R. MALLINA, 264 Riverside Drive, New York, N. Y. The invention has particular reference to means not only to provide a mark to indicate where the reader stopped reading, but which also holds the leaves of the book in position while the book is being read, while in no way interfering with the turning over of the leaves of the book. The device is constructed in such a way that it can be slipped on and removed from the book with ease.

PAPER DISPENSER.—A. F. LESLIE, 74 Dey St., New York, N. Y. Among the objects of the invention is to provide a dispenser for protecting toilet paper, and the provision of a simple holder adapted to dispense the paper one sheet at a time. The arrangement is such that the supporting members will act as cutters as the paper is removed. A further object is to provide means for preventing the paper from becoming tangled as the sheets are successively removed.

GOLD SOLDER.—W. and H. W. SHIFF, 336 Canal St., Brooklyn, N. Y. An object of the invention is to provide a simple and easily manipulated solder for use in the manufacture of jewelry made of so-called "white gold." A further object resides in the provision of a solder that has the proper color to conform to the color of the jewelry with which it is being used and yet which is easily manipulated and will at all times retain its original color.

MUSIC LEAF BINDER.—W. C. TRAHER, 863 Maitland St., London, Ont., Canada. The purpose of the invention is to provide a device of this character which will give the binder a rigid and substantial back adjusted for expansion in order to accommodate a varying number of music leaves and which is not likely to sag or to lose its shape when holding a relatively large quantity of leaves. With this device it is easy to remove any sheet of music without disturbing the others.

TOP.—F. E. BARTRAM, 811 Hollingsworth, Los Angeles, Cal. An important object of this invention is to provide an educational device in the nature of a pair of tops having a plurality of numbered faces, the numbered face of one top coating with the numbered face of the other. A further object is to provide an educational and amusement device which is simple in use and inexpensive to manufacture.

BOOKMARKER.—I. C. WISE, 623 20th St., Oakland, Cal. Among the objects of the invention is to provide a combination envelope and bookmarker or rather an envelope which when discarded may be converted into a bookmarker, so that the envelope may be made to serve two purposes and even a third, when it is considered that it may also be used for advertising features.

SMOKING PIPE.—A. G. BROMSTER, Amidon, N. D. The invention relates to pipes for smoking tobacco and has for its object to provide a pipe which has means for causing the smoke to pass a circuitous path before reaching the mouth of the smoker, thereby cooling the smoke and permitting a deposit of nicotine, but having means also for preventing the saliva from entering the flues in which the smoke is compelled to pass.

MAIL BOX.—J. A. NICHOLS, Box 304, Egan, S. D. Briefly stated an object of the invention is to provide a mail box which can be opened by the carrier without removing his gloves in winter or without other inconvenience. A further object is to provide a rural mail box having novel means whereby the letter carrier may quickly observe if there is any mail in the box, thereby saving time. It is also an object to provide a strictly weather proof construction.

PROCESS FOR RECLAIMING USED OIL.—J. R. MILLER, 3060 Brandon Rd., N. S., Pittsburgh, Pa. The invention relates to the reclaiming of oil such as is used in the crank cases of internal combustion engines. An object is to so treat the oil that the dirt will be coagulated, the volatile hydrocarbon with which the oil is contaminated will be driven off, and without causing any substantial change in the composition of the reclaimed oil, thereby producing to all intents and purposes an equivalent to the unused oil.

DISPLAY STAND.—G. J. HELENEK, 421 Hancock St., Long Island City, N. Y. Among the objects of the invention is to provide a construction which will display articles while holding them in a compact arrangement. Another object is to provide a stand for displaying tubular articles or rolls without using too much floor space whereby the rolls may be readily removed and reinserted without injury and in a minimum amount of time.

Hardware and Tools

FISHING TOOL.—C. H. BROWN, c/o Brown Welding and Machine Co., Breckenridge, Texas. An important object of the invention is to provide a fishing tool having a plurality of spring arms which diverge toward their forward ends and are provided with means for gripping the valve seat of the valve cage and thereby removing the valve cage on the rearward movement of the tool. A further object is to provide a tool in the shape of a spear which will readily enter the valve cage when the tool is lowered for removing the broken cages from oil wells.

KNIFE.—W. CLAWSON, 684 Folsom St., San Francisco, Cal. The invention has particular reference to a knife used for slicing bread or similar objects, the principal idea being to provide guide means in combination with the knife allowing a slice or a plurality of slices to be cut at a uniform thickness. It is further proposed to construct the guide member in such a way as to allow the cut slices to pass between the guide member and the blade and to fall away from the latter during the cutting.

PIVOT LATHE FOR WATCHMAKERS.—D. K. ROBINSON, 3410 Garrison Blvd., Baltimore, Md. An object of this invention is to provide a lathe for facilitating the inspection, straightening, adjusting, refining and polishing of the pivot joints of horological balance wheels and train gears. A further object is to provide a device which has one pivot supporting member movable on the axial plane of the pivot, and the other pivot supporting member movable in a plane transverse to the axial plane of the pivot.

LOCK SCREW.—A. FLENTJEN, Canton of Geneva, Switzerland. The invention relates to lock nuts of the type in which a longitudinally split locking nut fits into a conical recess of the ordinary nut. This lock-screw comprises a lock nut having a conical outer portion adapted to be introduced into a conical recess of a main nut, the conicity of the lock nut being different from that of the conical recess of the main nut and the cone of the lock nut and of the main nut diverging toward the respective outer end of the nuts.

DUMB WAITER LOCK.—J. E. PHILLIPS, 260 Convent Ave., New York, N. Y. The invention particularly relates to locks adapted for the doors of dumb-waiters or doors operating in a similar manner, and has for its object to provide a construction which may be easily operated from the inside, but cannot be operated or forced from the outside. The lock is extremely simple and is constructed to take the place of an ordinary bolt and lock at the same time.

Machines and Mechanical Devices

ROAD BUILDING AND DITCH CLEANING MACHINE.—G. A. STEVENS, Ringwood, Ill. The invention has for its object to provide an apparatus which when drawn over a road or ditch, will give the proper pitch or crown to the road or angle to the ditch and which is capable of a wide range of adjustment in accordance with the work to be done.

WIND TURBINE.—E. H. MANNING, Elkhart, Ind. An object is to provide a wind power device which includes a rotor adapted to be acted upon with full efficiency at all times, irrespective of the direction of the wind, and which requires no adjustment or shifting of parts to compensate for the changes in the direction or velocity of the wind impinging there against, and retaining the air currents within the limits of the device until the effective force has been spent.

AUTOMATIC HYDRAULIC APPARATUS.—P. SAMAIN, Cusy, Haute Savoie, France. An object of the invention is to provide a device by means of which the pressure exerted by a liquid in a conduit may be automatically controlled. A further object is to provide a device which will operate to automatically close the conduit in case the latter should break, when the rush of fluid will cause the displacement of a pendulum which operates to close the conduit valve.

YARN TWISTING DEVICE.—C. E. McLIN, Box 617, Rome, Ga. It is an object of the invention to eliminate all but one roller and to inject between the roller and the twisting spindle a cylindrical or semi-cylindrical rod which is corrugated, fluted, or bent at necessary intervals to receive the thread and around which the thread is drawn, or the rod may be supplied with a plurality of disks, whereby the disks when engaged by the thread will readily adjust themselves to prevent the strands of yarn drawn from the spools from piling up one upon the other.

REVOLVING CARD DEVICE.—C. E. SHAW, Box 18, Gig Harbor, Wash. The general object of this invention is the provision of a device having means whereby a number of cards may be exposed in rapid sequence so that the matter on the several cards may be viewed. A further aim is to provide a flexible strip whereby the cards are supported so that the continued exposure of the same will not weaken or crack the cards.

WATER POWER MOTOR.—M. I. TUTTLE and L. L. HILL, Belton, Mont. The particular object of the invention is to provide a water power motor wherein a plurality of gravity operated balancing tanks are utilized to transmit motion to a power shaft. A further object being to provide a mechanism for automatically controlling the flow of water into the tanks and discharging the water from the tanks, so arranged that the weight of a descending filled tank operates to restore an empty tank to a position where it may be refilled.

WORKING BARREL.—W. W. WARNER, Box 157, Nowata, Okla. Briefly stated, an important object of the invention is to provide a working barrel for wells, having means whereby sand or other granular material suspended in the liquid is prevented from settling on the pumping cups, thereby greatly prolonging the period of usefulness of the cups and preventing the loss of oil or water incident to the frequent replacing of the cups.

ATTACHMENT FOR SHOE STITCHING MACHINE.—T. F. McREYNOLDS, 110 E. Fifth St., Walsenburg, Colo. The invention relates to a shoe stitching machine attachment enabling the ready application of a welt strip. One of the foremost objects is to provide a guide operating in conjunction with a well known type of shoe stitching machine for the purpose of applying a welt strip to new or old shoes, as the shoe is manipulated in the stitching operation.

PULLING DEVICE.—E. W. BEAUTIGAM, 1101 E. Lakeshore Drive, Coeur d'Alene, Idaho. The object of the invention is to provide a lever chain pulling device wherein a single strand of chain is used and is controlled in such a manner as to prevent tangling, and at the same time is driven from the lever in such manner as to exert a powerful pull. Another object is to provide a device which is durable, automatically reversible and may be actuated by the operator to slacken.

SORTING OR SIZING APPARATUS.—LE ROY D. SPENCER, Box 76, Entiat, Wash. Among the objects is to provide an apparatus by which apples or the like may be sorted or graded into different sizes in a highly efficient and expeditious manner, and where by in sorting the apples or the like the same will not be bruised. The apparatus is simple in construction and inexpensive to manufacture.

PULLER FOR SLEEVE BEARINGS.—C. W. TRACY, c/o Tracy Pump & Machine Co., Visalia, Cal. This device is particularly useful in pulling "Timken" bearings. A bolt has a cylindrical block to be entered in the sleeve to be pulled. Dogs on the block are expanded by a tapered nut on the bolt into engagement with the ring; when the device is engaged with a sleeve bearing the turning of the bolt causes the nut to travel on the stem and this slides the block with the dogs to carry the sleeve bearing out of the housing.

MASTER TEMPLATE FOR GASKETS.—A. SHARPE, 31 McKibben St., Brooklyn, N. Y. This invention relates to templates for measuring devices, and has for an object the provision of means whereby ready measure-

ment may be made of irregular formations, such as gasket patterns etc. A further object resides in the provision of a combination of devices whereby the dimensions of irregular apertures in pipes or other passages may be measured and the variation from the required dimensions of gaskets to fit in said apertures may be readily determined

WIND MOTOR.—W R. TWIFORD 1306 N E Second Ave Miami Fla The invention relates to a windmill of the merry go round type, or type in which a series of blades is carried by a frame to revolve about the mast as an axis, the blades feathering to present in succession a broad surface to the wind at the wind side and to be presented more or less edgewise to the wind at the opposite side of the axis of rotation of the motor An important object is to provide a controlling wheel in substitute for the usual vane for controlling the blades.

PULVERIZING APPARATUS—J AUBE, 63 Avenue des Champs Elysees, Paris, France. The invention has for its object an apparatus which effects an economy of power, and is arranged to be easily dismantled and inspected This result is obtained by utilizing a turbine in such a way as to cause the air which has carried away the dust to return to the apparatus, after it has been freed therefrom and by evacuating the pulverizing products through the upper part of the apparatus by means of a circulating trunk communicating with the interior through openings which are adjustable

DENTAL ATTACHMENT—J J STARK, 564 Senator St, Brooklyn, N Y The aim of the invention is to provide an attachment for dental lathes, and more particularly a power mixer for material for making dental casts, and comprising self-contained structure attachable to the horizontal spindle of a dental lathe, such structure including a receptacle for the mix, and a beater therein rotatable about a horizontal axis.

VALVE.—A E. ROPE, Hillyer Hall, 102 Remsen St., Brooklyn, N Y Among the objects of the invention is to provide a valve having a turning movement and a longitudinal movement imparted by screw threaded engagement between the valve and the casing, whereby the valve is caused to tightly seat and form a water, air or steamtight juncture with its seat under any pressure. This valve can be manufactured at a reasonably low price.

OIL WELL EQUIPMENT—A. T HAGAMAN, Box 455, Oakland, Ky An important object of the invention is to provide a pumping means for wells having a supplemental or reserve traveling valve which is normally located in the lower portion of the working barrel and which is brought into play in the active portion of the working barrel when the main traveling valve becomes worn and unsafe for efficient pumping

DRILLING MACHINE MOUNTING—M SMITH, c/o L E Smith, Modesta, Cal An object of the invention is to provide a mounting for a machine of this type which is capable of a very wide range of adjustment so that the maximum scope of operation may be provided for the drill without resetting the drill on the main support. An other object is to provide a mounting in which the drill may be rapidly adjusted at different levels, so that the horizontal range of the machine may be multiplied by adjusting its vertical position without moving the support.

Prime Movers and Their Accessories

LUBRICANT GUN—G A PETTIT, L & N R. R. Co Shops, New Orleans, La. The invention relates to devices for forcing a lubricant into suitable receptacles or cups. An object is to provide a device of the character described which is designed primarily for use in filling the rod cups on locomotive engines The device is adapted to be operated conveniently to force a relatively hard lubricant therefrom into the oil cups.

VALVE ROCKER ARM.—R. E. HEDBERG, Grenfell, Saskatchewan Canada This invention relates to a rocker arm of the class commonly employed for operating the valves of internal combustion engines. An object is to provide a rocker arm so constructed that there is no danger of the valve being held off its seat allowing a leakage, and a rocker arm which will cause the valve operating parts to operate silently and in exact time with the rest of the engine, thus insuring a quieter and better running engine.

VALVE SPRING COMPRESSING MACHINE.—G S. ROBERTS, Box 52, R. F D 6, Los Angeles, Cal The invention particularly relates to that class of machine used in compressing the valve springs of internal-combustion engines for the purpose of assembling or disassembling the valves for grinding or repairing, etc A further object is to provide an attachment for the machine in the form of a shim punch so that the same machine may be used either for compressing valve springs or punching shims

LIQUID FUEL PURIFIER—T H GANNON Tucson Ariz The object of the invention is to provide a purifier for straining liquid fuel for use in internal combustion engines, to provide an arrangement of compartments and screens in such device and to provide means for easily cleaning the device

Railways and Their Accessories

AIR BRAKE VALVE—F E HARRIS c/o W H Hayes First National Bank Bldg Laramie Wyo The invention relates to air brake systems its purpose is to provide a valve adapted to be interposed between the triple valve and brake cylinder for controlling the passage of air to and from the brake cylinder in accordance with the pressure of air in the train line.

ANGLE COCK—F P CLAUSS 26 Maple St., Lyons, N Y Among the objects is to provide an air brake system for trains where in the angle cock cannot be closed or shut off until the brakes have been applied the arrangement being such that the setting lever is placed from the angle cock at such a distance that an operator cannot touch the setting lever and the angle cock at the same time

PROCESS AND MEANS FOR SWITCHING RAILROAD CARS—F W KAGELSTON, 1409 W Adams St Chicago Ill An object of the invention is to provide a process which makes use of a simple and economical car propelling means and may be readily installed in any switch yard for switching railroad cars A further object is to provide means for quickly classifying cars and reducing the number of locomotives necessary for the switching operation to a minimum The process will not prevent the yard being used in the ordinary way

SAFETY APPARATUS FOR RAILWAY ROLLING STOCK—H S VORAW Chopaka Wash The object is to provide a safety apparatus which is organized with the trucks of the rolling stock and which serves as a derailing guard in that it prevents the cars or trucks from leaving the railway and also serves to apply the brakes when the car wheels leave the rails and thereby stopping the train This apparatus will not interfere with the normal operation of the rolling stock

RAILWAY CROSSING—J P HOUK Mountain Grove, Mo The invention particularly relates to railway crossings of the type embodying means for automatically rendering the track rails continuous for the passage of car wheels across the crossing, thereby obviating the jars shocks and wear which would be caused by the wheels when they cross a gap between intersecting rails A further object is to provide a railway crossing which affords facilities for maintaining continuity of hard rails for trains traveling at right angles to each other

SAFETY APPLIANCE FOR RAILWAY SWITCHES—B R HOOKS Amarillo Texas An object of the invention is to provide a device which is adapted primarily for guiding the wheels of a train past a defective switch and maintaining said train on its direct route of travel A further object is the provision of a safety device for laterally shifting the wheels of a train from a defective switch point and which is also adapted to prevent injury to the switch points.

PANTOGRAPH—R B SPIKES 607 First National Bank Bldg, San Francisco Calif The invention relates to a device commonly known as a pantograph and used in connection with electric railroad cars for establishing a connection with a wire supported above the car An important object is to provide control means for pantographs that will answer automatically to pressure and will cause the contact member to rise and descend to meet any situation that may arise.

TRACK LEVEL—C M. LONG 1261 N Dearborn St. Chicago, Ill An object of the invention is to provide a track level which is adapted to straddle a track, and which has means for indicating the height at which one rail is disposed above the other rail A further object is to provide a device in which reading may be done from either side or from the top and which has means for automatically disposing the device at right angles to the rails

AUTOMATIC DRIFTING DEVICE FOR LOCOMOTIVES—B L HANSON 5331 Beach St Chicago Ill Among the objects of the invention is to provide a drifting device which will be automatically operated when the throttle of the locomotive has been closed while the engine is in motion thereby permitting a flow of dry steam through the valve chamber and cylinder thus preventing cinders soot and the like from being disposed in the valve chamber and providing a cushion of steam therein the device can be readily applied to locomotives of ordinary construction

RAILWAY TIE—T H BARNES 65 Broadway Norwich Conn An object of the invention is to provide a metallic tie wherein the rail supporting or bearing blocks are secured upon the body portion of the tie in such manner that the same may be readily removed and replaced when worn thus obviating the necessity of replacing the entire tie Another object is to provide an effective lock for securing the bearing blocks in operative position on the tie

AUTOMATIC BALL BEARING SIDE BEARING FOR RAILROAD TRUCKS—G M. HYNDES 1719 So Lamar Dallas Texas. The invention has for an object the provision of means associated with a side bearing whereby the shock of the weight of cars on the roadbed and rail joints is efficiently reduced so that the necessity for repairing the bed and the joints is greatly reduced

AUTOMATIC LOCK FOR RELEASE VALVES—R L LABACHOTIE 109 Brewster Ave Redwood City Cal Among the objects of the invention is to provide an automatic lock particularly designed to be used in combination with the release valves of an air brake and to provide means for locking the valve in its released position so that it is only necessary for the operator to open the valve the latter staying open thereafter means being provided in the air brake for causing the piston to return as the pressure is released

Pertaining to Recreation

CAMP APPARATUS J A FERNST, JR 98 North Ave Ridgefield Park N J An object of this invention is to provide a game apparatus in which a game such as baseball is played and in which the success of the game depends largely upon the skill of the operator in the manipulation of the apparatus A further object resides in the provision of means whereby the progress of the game may be very easily and plainly recorded

MARBLE SHOOTER—I S JAFFE 388 Sherman Ave New Haven Conn An object of this invention is to provide a toy which is shaped like a pistol and which is adapted to project a marble or other similar projectile with some force from the forward end of the shooter A further object is to provide a marble shooter with projecting mechanism which will be strong and durable and can be manufactured at a relatively low cost

ADVERTISING TOY—C W KUEN, 1520 Lakewater Ave Chicago Ill An object of the invention is to provide a device of the character described the use of which will not only afford entertainment but will serve as an effective advertising means in which the name of an article is revealed a portion at a time as the game progresses If a player is successful the entire name of the goods advertised will be revealed An ordinary pair of dice are used as counters

TOY PISTOL—L S BINFER c/o Kenton Hardware Co Kenton Ohio An object of the invention is to provide a means for preventing injury to the operator due to back fire or flash when the pistol is operated to explode a paper cap Another object is to insure the explosion of a cap by the provision of anvil and hammer the former of which is designed to receive and properly position the cap in the path of the movement of the striking face of the hammer

Pertaining to Vehicles

LOW PRESSURE ALARM FOR PNEUMATIC TIRES—W A HARRIS c/o Harris Accessory Co Greenville S C The invention relates generally to low pressure alarms for the pneumatic tires of automobiles and other motor cars. In this construction the movement of the stem is limited so that it can only seat at its inner end with sufficient pressure to be airtight, the parts of the device may be properly adjusted with ease and while being constructed to prevent accidental displacement, it may be readily removed by one understanding the structure.

AUTOMOBILE LOCK—S B CLAYTON 432 Church St Greensboro N C The object of the invention is to provide a locking device which is adapted for use with various types of steering mechanism and in which the lock mechanism is embodied in the lock itself and is protected without in any way impairing the capability of the lock the device being at the same time of simple and durable construction and reliable in operation, and inexpensive to manufacture

CURTAIN CARRIER—F F LAMICA, c/o Whiteside Cafe Chester S C The invention relates to curtains for vehicles provided with tops It is an object to provide a simple and efficient means for supporting curtains above the doors of an automobile or like vehicle so that the doors and the side curtains can be swung from open to closed position or vice versa without the necessity of detaching any part of the side curtains from a support.

EMERGENCY BRAKE LEVER.—O W POPP 1608 W 28th St Oklahoma City Okla Among the objects of this invention is the provision of a readily accessible emergency brake lever for applying the brakes to the rear wheels of a four door Ford sedan a two door coupe and a Ford delivery car with the lever being so positioned that the same will not inconvenience the occupants of the front seats of the car nor interfere with the operator of the car when entering or leaving

DIRIGIBLE HEADLIGHT—A C WOODRUFF Burns Ore An important object of the invention is to provide a dirigible headlight having means whereby the lamps are simultaneously turned either to the right or left as the vehicle changes its direction of travel also to provide means whereby the lamps may be tilted above a horizontal axis so that the rays will be directed downwardly or cast some distance in front of the car as may be desired

RADIUS ROD—J C HALDEMAN 96 Lincoln Ave, Salem Ohio The primary object of the invention is the provision of radius rods which may be readily utilized either in lieu or in addition to the usual radius rods with a view of forming more substantial support and less noisy action, and a further object is the provision of a radius rod having means whereby its end connections may be easily and quickly adjusted at all times to avoid rattling and other noises

GASKET PROTECTOR—M MCINTYRE 139 Center St Healdsburg Calif This invention is particularly designed to be used in connection with the transmission cover of a Ford transmission case An object is to provide a protector for the edge of the gasket which will guide the transmission cover past the gasket and which can be withdrawn after the transmission cover is in place The device comprises a strip of protecting material bent to overlie the edge of the gasket and having a flange adapted to cover the face of the gasket

SIGNAL—T J and E A TEMPLE 48 No Orange St Medford Ore An object of the invention is to provide a signal which is adapted to be positioned on the surface of the roadway so that its presence cannot be overlooked by persons traversing the roadway, and which in applied position does not obstruct or hinder in any way the passage of vehicles thereover The signal giving elements may be varied to suit the varying conditions of light or to give various signals to direct approaching vehicles

DOOR OPERATING DEVICE—C L MARSH Bridgewater S D The invention relates to a door operating device which is particularly adapted for use in connection with garages etc The invention aims to provide a door operating device by means of which an operator will be able to cause an actuation without alighting from the vehicle the doors being caused to automatically open upon the approach of the vehicle and subsequently close after the vehicle has passed through

SPRING MOUNTING—V W PAGE Victor Page Motor Co Melrose Ave Stamford Conn One of the objects of the invention is to provide a novel spring attaching means for securing the rear end of the springs to the axle housing A further object is to provide an arrangement whereby the working parts of the rear axle and spring suspension may be thoroughly lubricated.

The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals Other digests ordinarily appear in Electrical Notes, Service of the Chemist, and other departments which are omitted from this issue

Automotive

Oxidized Kerosene as Fuel—Experiments made by the research laboratories of the Carnegie Institute of Technology Pittsburgh, have shown the relative efficiencies of oxidized kerosene and kerosene as fuels Oxidized kerosenes cause less knocking tendencies than common kerosene when used in kerosene engines It was also demonstrated that oxidized kerosenes have about *the same power potentialities* as ordinary kerosene even though their thermal values are one eighth less This anomalous condition is due it is thought, to the better clean up in the combustion of partially oxidized fuels The successful outcome of this work promises that oxidized kerosene, which is manufactured from low grade petroleum by catalytic oxidation may become a useful fuel in the future Owing to its properties it may come to be used industrially in kerosene engines or as a blender with gasoline for use in gasoline engines

Knockless Gasoline developed by the General Motors Research Corporation in connection with Massachusetts Institute of Technology is on the market in one state and will be available all over the country as soon as production can be increased If *certain knocks are caused by a high pressure* high velocity wave striking the top or sides of the combustion chamber then suppressing the knocks is a matter of suppressing this wave The addition of 40 to 60 *per cent of benzine or alcohol* accomplishes this purpose but there is not enough of either of these fuels to doctor all the gas which we now use at the national rate of a 10 000 gallon tank car per minute Research showed that the knock could be suppressed by the addition of very small amounts of diethyl telluride one volume of this material being equivalent to 250 volumes of benzine as an anti knock material while one volume of lead tetraethyl equals 625 volumes of benzine in the same manner The new product is called ethyl gas'—*Tech Eng News*, 4 6 p 210

Performance Tests on Automobile Tire Casings conducted by the Bureau of Standards show some remarkable results In practically all cases the coefficient of friction at the start of motion is less than that during continuous motion—a result which is quite different from that usually applying in tests in which friction coefficients are measured On clean wetted surfaces the coefficient is in some cases higher than on the same surfaces dry This is true on concrete and in some cases on asphalt James is of the opinion that the slippery conditions often encountered on hard surface roads, especially when they are wet is due to the presence of a film of some foreign substance which in effect acts as a lubricant. Coefficients as high as 0 80 are quite general and of 0 90 or above not at all unusual The coefficient was 1 00 on one piece of rough concrete and actually reached 1 16 on dry plate glass in one case! The lowest coefficient found on any road surface among those tried was 0 54 on wet oiled asphalt Friction in motion transverse to the plane of the tire is usually about the same as that parallel to the plane and the configuration of the tread appears to have little if any effect on hard surface roads It was found however that *composition of tread rubber* had a marked effect upon coefficient of friction on hard smooth surfaces.—*Automotive Ind*, 49 22 pp 1091 96

Means for Increasing the Yield of Gasoline from crude oil by the application of cracking methods have recently been devised Depending upon the original character of the oil, this increase may be as much as 13 *fold* The oil is heated to about 875 degrees Fahrenheit under 500 to 600 pounds pressure while circulating through tubes in a furnace, and flows to a large insulated cylinder where the completion of the *cracking operation takes place* This cylinder or reaction chamber must stand heat pressure, corrosion by sulfur in the oil and be absolutely leak proof, for the gasoline under high pressure is well above *its ignition point* The use of *forged steel* cylinders for this purpose has met with signal success—*Iron Age*, 112 18, pp 1175 76.

Industrial Progress

The Cotton Manufacturing Center of the Country is today in the South It now produces considerably more than half of the cotton cloth made in the country Up *to a short time ago cotton cloth could not* successfully be made except in certain localities where the air was sufficiently moist and humid That is why Massachusetts and Rhode Island, with their broken coastline and numberless lakes and rivers resulting in constantly humid atmosphere became the center of the cotton industry in this country, precisely as Lancashire for similar reasons, grew to be the center of the industry in England No attempts to spin cotton in the South were successful until the humidifying apparatus was discovered This permits the fibers to be picked drawn and spun properly Mill expansion in the North has been practically non existent for the last two years A great deal of Northern capital has been put into Southern cotton mills and doubtless more will go in the same direction but so long as the mills in North and South Carolina and Georgia can produce more efficiently than those in the Bay State and Little Rhody—most of the money invested in the cotton business will be apt to go South—*Ind Digest*, 2 10 pp 750-51

Through Electro-deposition, metal patterns are made very accurately owing to the fact that there is no shrinkage involved Since these patterns are exact duplicates of the original in size shape and finish it is obvious that machining filing and scraping are practically all eliminated Patterns can be made of copper brass nickel or any other metal or combinations of metal (for example a nickel surface with a copper backing) The method of procedure is similar to that used in electrotyping Casts of wax, plaster of paris or any fusible alloy are taken of the desired pattern to be reproduced These casts are made conductive on the impression surfaces In the case of wax or plaster of paris graphite is used to make the conductive surface Contact wires are inserted in the casts to make a connection in the plating tank and conductive surface of the cast Suitable insulation is given these casts to prevent the metal from spreading on the non-conductive surfaces These casts are then placed in the *desired plating* solutions and are allowed to run until the desired thickness is obtained The casts are taken from the bath and the metal deposits removed They are backed up with some *suitable alloy such as white metal* to give strength if necessary The partings are then checked very closely and machined or ground off if required and from this point the procedure is identical with the old method This *method is filling* a long felt want in the foundry and is perhaps the one big advance step made in the producing of metal patterns in the last 25 years—*Metal Ind*, 21 12, p. 499

The Mercury Vapor Boiler provides for the vaporization of mercury expanding it through a turbine and utilizing the heat of the exhaust to generate steam from water this steam being put through a separate turbine That is, the mercury condenser surface is the steam boiler In this way advantage is taken of a much greater temperature range than is possible with steam alone, and the thermal efficiency approximates that of the internal combustion engine, namely, one kilowatt hour at about 11,000 B.t.u If

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we compare the mercury vapor process with a steam generating plant running at 200 pounds steam pressure and with the higher standards of efficiency in turbines and auxiliaries the mercury steam combination with mercury at 35 pounds gage should, according to one writer give about 52 per cent more output in electricity per pound of fuel And if in such a plant the boiler room is re-equipped with furnaces and mercury apparatus arranged to burn 18 per cent more fuel, the station capacity with the same steam turbines condensers auxiliaries, etc., would be increased about 80 per cent.—*Power*, 58 23, pp 876-80

Electrofanned Hogs represents the latest advancement in the use of electricity for every conceivable purpose On the 101 Ranch now the largest ranch in the United States, the head of a large herd of fancy hogs, known as "The Great I Am" has a special home with a device on which he has merely to step causing a large electric fan to be switched on Stepping on another board electrically turns on a showerbath In several small maternity houses for the sows, provision is made for electrically heated pads which are used when pigs are littered during cold weather to keep the new borns warm Power is generated by a 100-horsepower Diesel engine for which the oil is produced on the ranch, which lies within the Oklahoma oil field Natural gas secured in a like manner is used under boilers to generate steam Electric light is used to lengthen the working hours of hens thus increasing the egg output —*Mfr's Record*, 84 21, p 60

The Use of Bituminous Coking Coal as Water-gas Generating Fuel is found to be unquestionably preferred to that of coke at its prevailing high price according to investigations made by the Bureau of Mines Central district bituminous coals have been used to some extent during the past few years in Illinois and surrounding States as water gas generator fuel As prices of coal and coke advance with an increasing margin of difference between them the economy that can be realized from the use of coal as generator fuel increases When coal is substituted for coke and the same methods of operating used as with coke there is an appreciable waste of fuel which can be eliminated The amount of this waste per thousand feet of gas made will increase as the standard of gas is lowered The present tendency is toward a lower standard for *city gas One method of eliminating waste*—the use of a waste heat boiler with combustion chamber—is suggested and discussed in Technical Paper 274 by W W Odell, fuel engineer which may be obtained from the Department of the Interior, Bureau of Mines Washington D C

The World's Nitrogen Consumption increased between 1913 and 1918 from 808 031 to 1 285 308 net tons or 59 per cent the proportion derived from Chile and from coal decreased while that of fixed atmospheric nitrogen increased until the atmosphere supplied a greater percentage of the nitrogen consumption than either of the other sources The fixed nitrogen industry was thus established in the world and in 1922 we find the consumption of 875 000 net tons of inorganic nitrogen made up of 24 per cent from Chilean nitrate 35 per cent from the coke and gas industry and 41 per cent from the atmosphere In the United States in 1922, 179 000 net tons was used with production from coke and gas of 58 per cent and atmospheric plants 3 per cent of this amount In the peace time development of actual producing plants for nitrogen fixation the United States has taken practically no part less than 3 per cent of our present requirements being supplied by the fixation of atmospheric nitrogen within our borders The United States Nitrate Plant No 2 at Muscle Shoals has 40,000 tons capacity which shows that even though the Muscle Shoals plant were now operating we would then be producing but 20 per cent of our annual consumption in fixed nitrogen It is quite evident that no large nitrogen industry exists in this country today—*Chem and Metall Eng*, 29 24, pp 1047-50

A 22,000-Volt Electric Steam Boiler has recently been installed in a plant at Berlin, N H It is an 1800-horsepower boiler operating at 135 pounds gage pressure and its use takes the place of 69 long tons of coal in a day of 23 hours—coal worth $550 under the boilers it displaced The unique feature of the installation is the very

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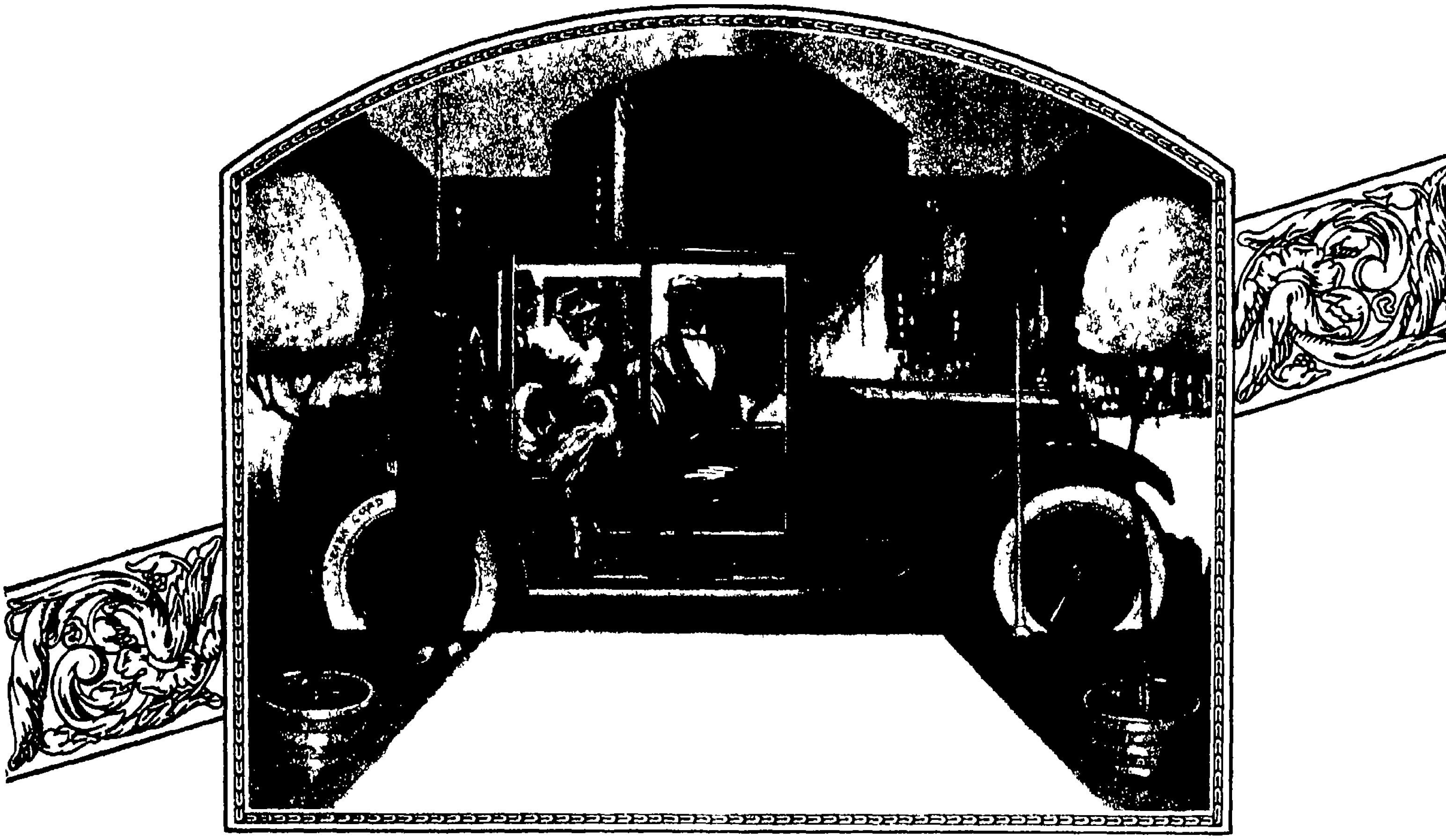

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high voltage used without a step-down transformer It was found that the necessary transformers would have been twice that of the transformers themselves, and since this installation was intended to be used only to hold steam over each Sunday in a plant where continuous steam was necessary to a paper making process, this would have been prohibitive But no electric boiler of such high voltage had ever been built or even attempted The installation is considered to be a most successful venture, the difficulties which had been anticipated not having materialized The matter of insulation of the conductors where they entered the tanks, the feared inability to operate at low load and the rapid wear of electrodes turned out to be needless worries. The cost of installation was $25 000 and it will have returned its entire capital cost in only 46 days This is largely due to block rates for Sunday power —*Engrs and Engineering*, 40 11, pp 290-91

St Louis is to Become a Steel and Iron Center, following the development of a new ore field near that city, according to *Manufacturer s Record,* a magazine devoted to the building up of industry in the South There is produced within a radius of 100 miles of the city of St Louis every necessary basic material including a portion of the iron ore the coal for making metallurgical coke limestone and other raw material and there now is growing in and around St. Louis a sea of smokestacks over the plants that have been and that are being erected for the purpose of utilizing the iron and steel All of the basic material is produced along the lines of the Missouri Pacific Railway The surface outcrop at Iron Mountain extends 8000 feet in the shape of a horse shoe going downward approximately 1000 feet with an average thickness of 10 feet Besides all this the primary ore apparently is present in vast quantities The vein already has been cut a distance of 224 feet, disclosing a potential tonnage greater than the approximate 4 000 000 that was taken from the mountain prior to 1920 There is available in the St Louis district everything necessary for the development of a great iron and steel center The Eastern Central coal field lies directly to the east.—*Mfr's Rec*, 84 21, pp 57 61

Mechanical Engineering

A Revolution in the Construction of Power Plants has taken place within the past few years The reciprocating engine of 10 000 horsepower has given way to the steam turbine of 87 000 horsepower The public service steam boiler of 350 pounds pressure of which a few were built in 1922 is succeeded in 1923 by the boiler of 1200 pounds pressure The 1500 pound boiler is under consideration here, and an experimental boiler for 3200 pounds pressure is building in England —*Iron Age*, 112 18, pp 1175-76

The Manufacture of Hardened Steel Rolls Has Recently Undergone an Active Development —Formerly, nearly all cold rolling of strip and sheet metal was done with chilled iron rolls In steadily increasing volume these are being replaced by heat treated hardened slightly drawn ground and polished rolls of alloy steel usually chromium chrome vanadium chrome molybdenum chrome vanadium molybdenum or chrome tungsten vanadium Fully hardened rolls of these alloys may be made much harder than chilled iron rolls the hardness runs in the neighborhood of 110 to 115 scleroscope They take a much higher finish produce a correspondingly better surface on the product and are reasonably long lived if treated properly, as they deserve to be for they are among the highest expressions of the steel maker s art.—*Iron Age* 112 18, pp 1175 76

The Manufacture of Crankshafts has been much facilitated by a new machine tool invented in Denmark It consists of two opposed milling heads on horizontal shafts carried by housings each with three adjustments and feeds at right angles to each other Between them over a pit, is a driven table provided with vise jaws adjustable toward each other and with reference to the axis of the table Clamped between these jaws in a vertical position, adjusted properly with reference to their axes the pins and webs of a crankshaft can be machined all over by the revolving cutters controlled by the feeds provided by the housings or by the revolution of the table There results

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a great economy of time in the machining.—*Iron Age*, 112 18, pp 1175-76.

Saving Worn Parts by Electrodeposition is a process which has been developed by the Westinghouse Research Laboratories for building up shafts, pins, bolts, gear centers and similar parts and which can be used for building up the worn bores of automobile engine cylinders Commercial salts are used and a current of sufficient density is employed to permit all ordinary repair work to be removed from the plating bath at the end of two or three hours. The cost of building up and machining is kept low enough so that it will pay to reclaim a piece with this process rather than use a new one While the research work has been carried on, over 200 pieces have been recovered for the Westinghouse plant, thus making the process help pay for its own development. This company is now installing a service station in the Pittsburgh district to handle all kinds of work that can be reclaimed by electrodeposition A plating bath made up in the following proportions has proved best 2.5 pounds of commercial ferrous ammonium sulfate per gallon of city water plus a small amount of ferrous carbonate (*freshly precipitated and kept* under water in order to keep the solution practically neutral) plus a small amount of powdered charcoal, which helps to prevent pitting The equivalent amounts of commercial ferrous sulfate and ammonium sulfate may be substituted for the ferrous ammonium sulfate If the solution is made up from the ferrous sulfate and ammonium sulfate, the *granular or "crystal meal"* ferrous sulfate should be used The ammonium sulfate must prove to be free from sulfocyanate when tested with ferric-sulfate or ferric-chloride —*Brass World*, 19 11, pp 373-75

High Steam Boiler Pressures are a post war development and at present there is a wide difference of opinion among engineers on this question Some look on it as a natural development, and others as a passing fad In this connection it must be remembered that if the total temperature is fixed any increase in pressure means a decrease in superheat For example, with 750 degrees maximum temperature there would be 360 degrees of superheat with 200 pounds pressure 300 degrees with 400 pounds, 184 degrees with 1200 pounds and only 40 degrees at the critical pressure of 3200 pounds. At the present time the steam pressure in a great majority of commercial plants does not exceed 250 pounds A small number of plants are operating in the range from 250 pounds to 600 and perhaps a half dozen others are under construction at the present time So far as can be determined no American boiler has been in operation for long at pressures above 600 pounds After a few high pressure plants have been in operation more will be known of the actual results from their use and it is altogether probable that steam pressures of 800 pounds and upwards will when combined with reheating and back pressures, be found advantageous from a broad economic standpoint. —*Power*, 58 24, pp 966 67

A New Form of Heat Treatment Bath in which tools or parts may be treated in the finished shape without deformation oxidation or decarbonizing has been developed The base of the molten bath is understood to be treated lava, which is supplied in metal containers When heated to the proper temperatures these materials form mobile liquids of high specific heat and of a specific gravity of only about one-sixth that of the lead bath No hood or ventilation system is required, as no fumes are evolved Heat treatment of parts, such as gears, piston pins, tappets bearing races drop forging dies and die casting dies and production treatment of edged parts like scythes, auger bits, etc has been accomplished with unusual success by the use of treated lava. This process was developed during the war for the heat treatment of small ordnance parts. As the material is neutral to steel, no scale of any kind forms and production is greatly increased This property, together with the ability to form protective coating over the parts as they are put in the bath, allows the treatment of completely finished parts. As the parts are taken from the bath, a protective coating is again formed, preventing oxidation while parts are transferred to the next bath. This protective coating, together with the turbulence of the mobile liquid due to convection currents, causes uniform heating of the part in the bath and therefore eliminates distortion.—*Automotive Ind.*, 49 23, p. 1147

Electric Furnaces far outclass the best production practice of any of the combustion furnaces in every factor, and from every standpoint, except perhaps the first cost of the installation They greatly simplify the labor problem and render the manager independent of the melter They permit the routine repetition of the melting schedule, which has been reduced to the mere charging of the metal into the furnace, stirring and skimming it if necessary and, when melted, pouring it. The time and temperature of pouring are decided by pyrometer and can be placed under the eye of the manager or superintendent at all times. It is conservative to say that the metal can be melted for half the cost of that of combustion furnace practice, considering the cost of fuel, metal loss, upkeep, etc., and this, not considering the indirect savings in the improvement of the product, uniformity, reduction of rejections, satisfaction of the customer, savings in floor and storage space, absence of worry, and so on. The improvement in working and sanitary conditions in the foundry, brought about by the use of the electric furnace, are highly important items there being absence of noise, heat and fumes There are four principal types of electric furnaces in use in this branch of melting the open arc, the muffled or smothered arc, the resistance and the induction furnaces.—*Iron Age*, 112 19, pp. 1283-86.

Metallurgy

Dirty Steel gives far less uniform results on endurance tests than cleaner steel, and dirty steel is certainly unreliable and unsafe when repeated vibration must be endured These inclusions, or other similar inhomogeneities in the metal are probably the cause of many failures in service. The endurance properties of any really clean steel may be quite safely predicted, according to conclusions drawn from tests made by the University of Illinois in cooperation with the Bureau of Mines of the Department of the Interior But when the steel is not clean it may either give the same results as a clean steel or far poorer results depending on whether the most severely stressed spot in a piece made from the dirty steel happens to be locally clean or locally dirty According to these investigations, cerium offers no promise of usefulness as an *alloying element in steel Its use tends* towards the presence of nonmetallic inclusions and toward troubles consequent upon this defect.—*Iron Age*, 112 20, p. 1330

American Graphite as compared with the imported material was the subject of experimentation made at the plant of two users of graphite crucibles It was found that Alabama graphite bonded with the American clays gave superior service, a service at least equal to the commercial crucibles of the same class which have been sold on the open market Ceylon graphite which is considered by many manufacturers to be best for crucible work, was third in the list of tests and Canadian graphite which had been recommended very highly because of its structure was last in the list.—*Metal Ind.*, 21 12, pp 477 78.

The Deposition of Chromium on Metals by Electroplating is exciting some interest in Great Britain and the subject is under investigation at some of the Sheffield works. Some doubt is felt as to the commercial possibilities of the process. Chromium is four times as costly as nickel but that would not be a serious factor provided the operation of plating does not prove to be more expensive. Chromium is said to give a much more durable surface and there is said to be a substantial saving in time and labor, as plating with chromium occupies only one-third of the time taken for the deposit of nickel and the articles come out of the solution in a highly polished state Lead anodes can be used and these do not deteriorate in the solution. It is asserted that an ample coating of chromium can be deposited on brass in two minutes and that as the copper does not penetrate the chrome there is no necessity for subsequent buffing The chromium, it is claimed, is also so worked into the base metal that rust cannot settle between the two.—*The Metal Ind.*, 21:12, p. 488.

Molybdenum was first tested in rolls during 1920. Since then compositions of varying analyses and uses have been developed. Molybdenum is now used in all the four classes of rolls, namely: Low-carbon steel, high-carbon steel, iron cast in sand molds (sand rolls), and iron cast in metal

molds (chilled rolls.) For the severe service in blooming mills and roughing mills, the low-carbon steel molybdenum roll was developed, yielding a high degree of strength, toughness, and wear. Analyses and treatments of alloy steel and alloy rolls have received a new impetus. It is true that molybdenum is a contribution in this progress backed by sound reasoning and splendid service. The data so far gathered from hundreds of molybdenum steel and iron rolls and repeat orders from many steel mills are definite evidence of the merit of molybdenum as an alloying element in rolls. With the experience that has been gained during the past three years it is only logical to expect further advances and a solution of problems which will benefit the industry as a whole.—*Iron Age*, 112 23, pp 509 10

Adding Nickel to Babbitt Metal is not justified on the customary basis. It has been the practice of some engineers and manufacturers to add nickel to white anti friction or bearing metals but the actual object of this has been the subject of some controversy. It has been largely held that the original idea was not a metallurgical or even an engineering one, but to provide a means of identification of a certain manufacturer's metal after the bearing had been cast. The practice was adopted in other quarters, thus destroying the original object of providing identification. As excellent alloys were so treated, some virtue gradually became attached to the nickel content. Lengthy tests made in England, and presented to the British Institute of Metals now make it appear that the presence of a small quantity of nickel has the effect of combining with or dissolving in the copper present, and that the copper-tin compound is suppressed, hence the alloy loses that valuable property of resistance to crushing which it appears to owe to the interlocking of the copper tin compound in its dentritic form, and the hardening effect, if any, of the nickel does not compensate for the loss of this form of structure. Thus it would appear that the addition of nickel in such proportions to alloys of this character does not justify itself.—*Metal Ind.*, 21 11, pp 433-34.

The Soderberg Electrode is widely used in Europe in electrothermic industries. It has demonstrated its value in tilting electric steel furnaces and will also be a contributing factor toward cheaper electric steel. This method of forming the electrode in the same furnace in which it is used was at first frowned upon. With the improved understanding that has come from experience, the technical problem of the self baking electrode has been solved. Numerous carbide and ferroalloy furnaces in Norway, Sweden and Germany have been enjoying the savings which the continuous self baking method makes possible, for several years past. The Mitsui Co recently purchased the rights for Japan and is using Soderberg's in carbide furnaces, totaling more than 60 000 kw capacity. In France, Italy, and South Africa plants are now in operation using this method. Several plants abroad are already using with considerable success a process consisting of blast furnace metal to metal mixers, metal mixers to Bessemer and Bessemer to electric furnaces—eliminating entirely the open hearth furnace. Cheap steel of high quality and uniformity can be produced by this process at a cost comparable with the cheapest production methods now in vogue. The amount and cost of electricity used is quite small and the introduction of the self-baking electrode, developed in Norway under the name Soderberg, not only will cheapen refining costs, but will render possible the design and operation of electric furnaces of very much larger capacity than any existing furnaces.—*Iron Age*, 112 24, pp. 1585-86.

Tellurium as an alloying material with steel was the subject of investigations made at Massachusetts Institute of Technology. This metal has not been one of the elements used for alloying purposes with steel. It does not tarnish in moist air, and this property may be of commercial importance. At present the uses of the metal are very limited, and the production is small, the possible annual supply from the copper refineries being only about sixty tons. The telluride of gold has been known by metallurgists for many years, and an iron-tellurium has been successfully made. Tests were made at an electric furnace where regular steel castings were being made. One thousand pounds of steel was tapped into the ladle and twenty pounds of metallic tellurium was added. Analysis shows that about 40 per cent of this was retained by the steel. The results showed a somewhat lower ductility than would be expected in a well annealed steel casting with carbon 0 24 per cent and an explanation was sought in the microstructure. The new constituent was seen, and has been provisionally called telluride of iron.—*Iron Age*, 112 24, pp 1575 76

The Prevention of Corrosion of Steel formed the subject of tests made at the Federal Laboratory for Tests of Materials at Zurich, Switzerland and the following results were obtained. Aqueous solutions of salts of chromic acid after reaching a certain concentration preserve iron from rust for an unlimited time without the protecting action of the solutions becoming enfeebled or exhausted. The passivity contributed to iron by these solutions only lasts so long as the metal is immersed in them. When added to these solutions, certain salts notably the chlorides of the alkalies and alkaline earths and also to an extent not quite as great, the sulfates of these metals reduce, paralyze or reverse the protective action of the chromic salts, while other salts such as for example the carbonates of the alkalies and lime reinforce their action. The protecting action of the chromic acid salts is not exerted solely on all kinds of iron and steel but on other metals such as copper, tin brass bronze etc whether they are isolated or in metallic contact with iron. For instance small samples riveted together have been immersed in a 2 per cent solution of bichromate of sodium and are as brightly polished today as at the start of the test. It is stated that numerous experiments extending over six years have shown that a solution with 0 1 and 0 2 per cent potassium or sodium chromate rendered slightly alkaline with sodium carbonate, suffice in most cases to protect iron and steel from rust

The Use of Oxygenated Air in metallurgical processes is being investigated by a committee which is sponsored by the Bureau of Mines. This committee has developed plans for experimentally determining the effects of oxygen-enriched air on the operation of the blast furnace, and has recommended that these plans be put into effect as the first step of an extended research on the general applicability of oxygen in metallurgy. The findings of the committee on these theoretical studies are revolutionary. After a critical review of the facts the committee concluded that, in the present method of smelting iron, it will be practical to increase the oxygen content of the blast 21 per cent to 31 per cent and that this enriched blast, when fed to the furnace cold, will increase the production of the furnace by 18 per cent and decrease costs by 6 7 per cent. The study of this problem has firmly convinced the committee that with the application of oxygen to present blast furnace practice the cost of production will be decreased the output per furnace will be increased, closer chemical control will increase the uniformity of the product cheaper materials, ore of lower iron content and coke higher in ash can be used and it is believed that the sulfur content of the iron can be reduced. This rendering available low grade and previously wasted ores will in the end mean the highest type of conservation and conservation at a profit.

The Early Claims for Molybdenum as a specific against fatigue failure of steel which alleged, directly or by inference that molybdenum steels were vastly superior to other steels for uses to resist vibration have not been substantiated in the over enthusiastic form in which they were made. The Bureau of Mines' experiments show that, with one exception molybdenum steels and other alloy steels containing nickel chromium, vanadium, or a combination of these elements have equal qualities of endurance and that no one alloy steel stands out above the others on this score. The exception is in favor of heat treated molybdenum steels for the presence of molybdenum makes the steel require a higher temperature in the drawing or tempering process after quenching, and this higher temperature causes fuller release of quenching stresses. The presence of quenching stresses tends to cause poorer performance under repeated vibration. This however, is not a very great factor, and has a noticeable effect only in very hard steels, for example, those of spring temper. For ordinary structural uses, no alloy steel is appreciably superior for use against vibration to any other when the steels are used in such sizes that they harden throughout on quenching. Molybdenum and certain combinations of nickel and chromium confer depth-hardening properties on steel, and hence these have advantages for use in parts of large cross-section. Thus it is evident that, as regards endurance, molybdenum

steels are the equals of any, and on some scores have slight advantages, but the advantages are slight instead of large

Mining

Perfecting the Centrifugal Mine Pump for Handling Acidulous Mine Water has been a development of the last 10 or 12 years. Along with this development the designer has been able to greatly increase his efficiencies until at the present time there is not the marked difference in that regard which formerly existed between the two types of pumps. Operating efficiencies of 70 per cent at 1000 g p m and 80 per cent at 3000 to 4000 g p m can be obtained with centrifugal mine pumps at the present time. The centrifugal mine pump also has evolved from a fairly complicated piece of machinery with diffusion vanes to a simple unit without diffusion vanes and few moving or wearing parts. The operation of the automatic centrifugal mine pumping outfit is as follows. A motor-driven vacuum pump controlled by a float switch in the sump is used for priming the centrifugal pump. Vacuum regulators, pressure regulators and bearing thermostats are used and connected in such a manner as to give ample protection to the pump and motor. The motor is protected against hot bearings, excessive overloads, failure of power, and the pump against excessive suction lifts, air leaks, lack of priming or broken discharge lines.—*Coal Age*, 24 24, pp 885-87

The Recovery of Asbestos Fiber from its ore by a wet process instead of by the hitherto universally used dry treatment is the purpose of a new 25 ton per hour plant that is to be built at Thetford Mines, Quebec. If the claims of the company, based on work done during the past year in the specially built experimental plant are realized this new process promises to revolutionize the asbestos industry. A peculiar feature of the asbestos industry is that there has been devised no method of "assaying" asbestos ore. In the first place, there is no known method of recovering all of the asbestos present in the rock due to the fact that if the rock is pulverized sufficiently to release it a part of the fiber is also reduced to dust. Another difficulty is due to the fact that long fibers have a higher value than short fibers, therefore, to 'assay' the ore, it is necessary to know the length of all of the fiber as it occurs in the ore. No matter how carefully a small sample may be handled there is apt to be some breakage of fiber which would of course tend to reduce the value of the sample. The problem for operators therefore resolves itself into the question as to how much can be recovered from the ore not in terms of fiber but in terms of dollars. It is claimed that the process will recover from two to four times as much *measured in dollars per ton* as is recovered by dry methods from the same ore. This has been arrived at by comparing actual recoveries in dry plants with recoveries obtained on lots cut from the regular mill run. The selective treatment process differs essentially from the method at present in use in that it employs water as a medium of treatment. The ore is first broken in the usual way to reduce it to 2½ or 3 inch ring. A Marcy ball mill is then used for further treatment. It is contended that by proper regulation of the mill operation the asbestos is freed with a minimum of breakage of the long fiber. The mixture of fiber and rock is delivered to a special type of separator.—*Eng & Min Jour Press* 116 23, pp 696 97

Ninety five Per Cent Extraction of Coal mine Pillars was made possible by a new method practiced in a Colorado mine. The new practice in pillar drawing is to maintain a parallel front on all the pillars in a given area that are in process of being cut back. The plan is to avoid leaving large stumps but to remove all the coal possible. The retreat is made by driving through the inner ends of the pillars and then running a series of short machine cuts across the end of each pillar until it is carried back thirty feet. This takes the place of the one long cut, which weakened the pillar from end to end. When the inner ends of a row of pillars have been cut back approximately thirty feet with faces kept at right angles to the line of the pillar, the bottom is shot up, props are pulled, some of them fit for re-use in spite of the heaving tendency of the bottom, the roof coal is brushed and the area left unsupported. In a short time the whole area caves and the weight on the standing coal is greatly relieved. Then the pillars are ready for further drawing, men again re-enter the room with mining machines. Again the retreat is made toward the room necks. After each cave, of course, it is difficult to reach the tip end of the pillar. However, the next cut is started as close to it as possible and the stump that is left after a crosscut has been driven is small indeed, for if it were wide it would interfere with the next cave-in. Sometimes a shot is used to make the roof collapse. By this method recovery is brought up to its maximum. In spots it is almost complete, but 95 per cent is a fair estimate *of the average recovery* according to the superintendent.—*Coal Age*, 24 19, pp 695-96.

Centrifugal Concentration.—In connection with experimental work performed some time ago by the Reno, Nevada, station of the Bureau of Mines, on the concentration of a zinc descloizite ore carrying vanadium, a laboratory size centrifugal concentrating bowl was developed for extracting metals from the slimes that represented the major portion of losses in the table concentration *of the descloizite ore*. More recent experiments indicate that the bureau's concentrator may have a commercial application to a neglected field of metallurgy, the concentration of slimes that are not amenable to flotation, or that it may possibly compete with flotation itself in the treatment of some ores. Improvements evolved have been incorporated in a design for a small commercial machine with which further experiments may be conducted under plant conditions

Conversion of Clays to Aluminum Sulfate.—In connection with the development of a simple cheap process of preparing pure solutions of aluminum sulfate, work has been undertaken at the Pacific Experiment Station of the Bureau of Mines on sulfating clays by various methods. Sulfate roasting, using gases containing varying amounts of sulfur dioxide to sulfate the aluminum silicate of the clays proved impracticable, but favorable results were obtained by treating the clays with sulfuric acid. A wide series of aluminum silicate products was treated at various temperatures with differing strengths of acid. In general nearly all the silicates were decomposed with fair efficiency at temperatures up to 200°C and with acids containing 50 per cent to 70 per cent sulfuric acid. The easiest silicate to decompose was bentonite, but many of the kaolins were quite easily attacked. Feldspars are much more resistant

Recovery of Zinc in Leaching Complex Ores.—It has heretofore been deemed impossible to leach an oxidized ore containing a large amount of zinc silicate with sulfuric acid. Research work performed during the present year by the Salt Lake City station of the Bureau of Mines has shown (1) that by handling the oxidized ores with the sulfide the mixtures may be made self supporting as to acid when the zinc sulfate formed is electrolyzed, (2) by the use of leach liquors of proper acid strength throughout the process any trouble due to soluble silica may be avoided. Practically this means that the present hydrometallurgical process for the treatment of zinc sulfide ores may be enlarged in its scope to include ores of almost any class and thus that large amount of zinc now being run into smelter slags at a great cost, may be saved

The Application of the Chloride Volatilization Process to the recovery of metals from complex ores is being continued at the Salt Lake City station of the Bureau of Mines. Gratifying results have been obtained on two types of ores selected for experiment as being most amenable to treatment by this process. These are (1) "dry" silver ores whose high lime content renders them difficult to treat by the Holt Dern process (chloride roasting and brine leaching) and whose base metal content would make the cyanide consumption prohibitively high for cyanidation, and (2) zinc sulfide flotation concentrates containing lead. The treatment for dry silver ores was successfully worked out in cooperation with a mining company on a semi-commercial scale, and a commercial plant is being planned. Experiments made by the Bureau of Mines with the zinc concentrate have shown that the lead may be almost completely removed by volatilization either as oxide or chloride. The work was checked by using representative ore from Butte, Montana, and from Nevada. The process was tried on a semi commercial scale at Harbor City, California, and was found to be successful. It offers a ready means for the zinc retort plants to remove the lead from the concentrates before retorting, and for recovering the lead in a bag-house. Small shippers will also find they

can recover their lead and save greatly on freight The lead oxide product is acceptable to the smelter without more treatment.

In the Work on Ore Classification problems in treating complex lead zinc ores of the Coeur d'Alene and other mining districts of Idaho, an improved type of hydraulic classifier has been developed by metallurgists of the Department of the Interior attached to the Moscow Idaho field office of the Bureau of Mines It is believed that this new classifier is more efficient than any now in use and that it represents a distinct advance in metallurgical treatment The new classifier has been tried out on a commercial scale in one of the mills with the result that a greatly improved grade of classification is being effected It is believed that table concentrations will be greatly improved when the tables are fed with good classified material It also appears that with this type of classification, *galena and sphalerité may be separ*ated on tables into marketable products and that much of the fine grinding and difficult flotation treatment of complex lead zinc ores may be eliminated

Transporting Ore by Airplane with obsolete ships or military machines rebuilt into commercial carriers is a subject which receives a full analysis in *Eng and Mining Journal Press*, Vol 116, pages 797 802 In an example given it was estimated that assuming the distance between a mine and the nearest railroad shipping point to be twenty miles, two airplanes of the cantilever monoplane type with 200 H P motors should in an eight hour day fly out with sixteen unit loads of 1200 pounds each Taking into consideration fuel consumption depreciation salaries hangars and fields and interest on investment, a total charge estimated at $88 *a day the cost of moving the ore would be* fifty five cents per ton a mile Three planes would be required, allowing one in reserve and it would be necessary to keep in employment one pilot two mechanics and one helper Undoubtedly there are many mining districts which are unproductive because of poor facilities for transporting high grade ore over very inaccessible territory It is certain that in some of them the cost *of bringing ore out to the railhead would* exceed the cost of airplane freighting

The Geophone, which helped in stopping the underground mining operations of the Germans during the war is now serving those who use explosives for purposes of peace Until the geophone was invented the listening instruments were all electrical The geophone is entirely mechanical The inferiority of the electrical instruments is that they do not respond to the very faint sounds a certain sound intensity is necessary before they will operate With the geophone *sounds so faint that the listener has the* sensation of feeling rather than hearing them can be detected and accurately identified The geophone is essentially a small seismograph It was invented by the French during the war and was developed by the United States engineers When the instrument is placed upon the ground, the vibrations set up in the earth by any pounding or digging will rock the geophone The case *of the instrument vibrates with the earth* The heavy lead weight suspended between elastic diaphragms remains because of its inertia practically motionless The relative motion thus set up between the weight and the instrument-case buckles the diaphragms and alternately compresses and rarefies the air in the top of the instrument This air vibration is carried through the tube to the operator s ear Geophones for locating miners imprisoned after a disaster are included in the equipment of the Bureau of Mines rescue cars They have proved to be of practical value for rough mine surveying for bringing tunnels together, and for preventing accidents in blasting through Successful results have also been obtained in *locating leaks in water mains*—*Explosives Engr*, 1 7, pp 186-87

That the Cost of Coal at the Mines *may be reduced in many cases by 30 per cent* is not theory but is based on a thorough analysis involving detailed time studies of the operation of loading machines, is the conclusion arrived at by Stanford F Thompson and associates to the U S Coal Commission summarized in several issues of *Coal Age* This figure is conservative and is based largely on the use of the loading machine If this method of loading is used loading is performed at a *fraction* of the time and cost of hand loading, undercutting can be performed more systematically and

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The Service of the Chemist

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Eucalyptus Oil as a Motor Fuel.—The Australian Commonwealth Government is interesting itself in certain experiments which have been made with the intent of using eucalyptus oil as a motor fuel The experiments were performed by Captain C M. Dyer who claims to have established that eucalyptus oil can be used in gasoline engines, with efficient means of vaporization The only difficulty is that it will not start an engine from cold without priming On the other hand, the calorific value is high. Tests made with cheap cars are reported to have shown that a run on gasoline gave twenty four miles to the gallon When the cars were run on a mixture containing half gasoline and half eucalyptus oil, twenty eight miles were obtained per gallon, while when run on eucalyptus oil alone, as much as thirty six miles per gallon of the fuel were obtained He states that eucalyptus oil will mix well with gasoline benzol and alcohol, and that it acts as a decarbonizing agent, maintaining the cylinders and pistons free from carbon There are seventy different varieties of the eucalyptus tree in Australia The oil yields range from 0 02 to 35 pounds per thousand pounds of the leaf treated Distillation is a simple process requiring no skilled labor The main difficulty of manufacture on a large scale would be labor for gathering the leaves.—*The Chemical Age of London*

Ethylene and Acetylene as Anaesthetics.—According to the *Klinische Wochenschrift*, 1923, page 113 both ethylene and acetylene have been used with considerable success as anaesthetics The gases used are mixed with oxygen Ethylene seems to have an advantage over ether in that it does not have the disagreeable after-effects of the latter About 515 major operations have been performed with acetylene A mixture of forty parts of acetylene and sixty parts of oxygen is used A little oil of pine is added to hide the odor of acetylene

Petroleum Oil from Rosin—The Japanese chemists have been experimenting for quite a long time to produce petroleum synthetically They have had quite some success in making petroleum from fish oil Japan does not possess any extensive oil fields and so has to import its oil from this country and Europe In the attempt to provide means for manufacturing petroleum from natural resources so as to fill the oil needs at home, an investigation was made to see if it were not possible to convert rosin into petroleum The process has been reported a success It consists in heating the rosin with acid earth, silicate of magnesia under ordinary pressure The oil that is obtained by this treatment, varies in color from a pale green to a water white It has a carbon content of 88 6 per cent and yields on distillation after purification with sulfuric acid, 50 per cent of naphthenes 40 per cent of aromatic substances and 10 per cent of unsaturated compounds.—*Oil Paint and Drug Reporter*

Rubber Celluloid Product.—Rubber and celluloid are combined to form a uniform mixture, known as celluloid rubber, according to a process which is described in the *India Rubber Journal* The rubber is dissolved in benzine and the celluloid in amyl acetate and from these solutions there is obtained an emulsion by the aid of hexalin When this emulsion dries, the constituents do not separate from one another In this manner a quick-drying varnish is obtained, which sticks fast to metals and glass but which is not very elastic. When about 5 per cent of celluloid is added to the rubber, the product remains soft and pliable. When 10 per cent of rubber is added to the celluloid, the latter is made flexible and less liable to break.

Destruction of Platinum Crucibles.—The destruction of platinum crucibles is always traced back to changes that take place in the chemical nature of the metal. This can be prevented by the avoidance of unnecessarily high temperatures when igniting precipitates, etc., in the crucibles. The compounds of platinum with carbon, silicon, boron, phosphoric acid, etc., are formed by the reduction of the salt which commences at a comparatively high temperature. The fact, that platinum at that temperature is pervious to hydrogen and hydrocarbons, makes the accomplishment of the reduction process much easier Hence, in heating platinum crucibles in ovens, it is of prime importance to see that the atmosphere in the same does not possess a reducing character For the same reason it is very bad to use acetylene for heating the crucibles as the life of the same is very greatly reduced by such practice The ashing of organic substances should always be carried out at a temperature that is as low as possible. Ignition of the mass at the temperature of the flame of the blast lamp or in the oven should not take place until all the carbonaceous matter has been burnt off. Fused alkalies alkali carbonates in the presence of sulfur, likewise cyanide of potassium attack the platinum crucibles very strongly at elevated temperatures For further details see *Chemiker Zeitung*, 1923.

Waterproof Paper and Board.—A process has been patented for the manufacture of a water resistant paper or board, in which the paper is impregnated with a mixture of a wax soap, such as potassium or sodium oleate, with a binding medium such as glue or casein alkali and formaldehyde, and a filling substance such as barium sulfate, calcium carbonate or precipitated aluminum hydroxide Colored fillers such as metallic compound of aniline colors may be used. After drying the surface is rubbed down and smoothed by calendering and the pores are closed in this manner To produce a good insulator, the material is soaked in linseed oil train oil, paraffine or other oil or fat before smoothing A harder product is obtained by uniting two or more layers of paper with iron resinate or other laclike substance mixed with a little oil, and impregnating and finishing the product as above described —*The World's Paper Trade Review*

Patent Litigation, Its Causes and Results.—The causes of patent litigation most frequently lie in defects in the patent itself It should define the invention clearly and not too broadly This will be done if in the case of chemical and metallurgical inventions the patent chemist is given free hand in the preparation of the claim and the specification Competent examiners in the patent office are most essential. Courts should have technical advisers. Two instances of hardships worked by decisions in patent litigation are given in some detail In one case, a patent for a thing really novel, but too broadly claimed, was declared invalid In another a patent limited in its language but covering a novel and valuable discovery was at first declared invalid and not infringed and on appeal was sustained but ruled by the majority of the court as not having been infringed.—*From a paper read before the Milwaukee meeting of the American Chemical Society*

Tensile Properties of Cotton Yarn.—An investigation was carried out to determine the effect of important variables, such as moisture content, temperature prolonged heating and lubrication on the tensile properties of cotton yarn Two distinct varieties of cotton were studied, using an apparatus which permitted of close temperature and humidity control. It was found that up to about 12 per cent moisture, the tensile strength is increased, but beyond this even soaking in liquid water produces no further increase in strength. Increase in temperature from 20 to 140 degrees caused a decrease in tensile strength in the case of dry yarn of about 40 per cent. At any given temperature and humidity, the tensile value of practically a resultant of the two effects alone. Baking the yarn at 110 degrees centigrade for eight days caused only a slight decrease in the strength, but at 140 degrees centigrade the rate of decrease was rapid. Solvent extraction of the yarn thus removing the natural fats and waxes, caused an increase in the tensile strength of approximately 30 per cent, while the addition of castor oil to this extracted yarn reduced its tensile strength considerably, but not down to the value of the original yarn.—*Paper read before Milwaukee meeting of the American Chemical Society*

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phenomena of any description whatever

There remains the claim that this failure was due to bad psychic conditions. Dr Vecchio catalogued two such—the long time occupied in the tying and the size and character of the audience. If this sitting were an isolated one, these claims would both deserve the most serious attention. But the tying consumed more than an hour on both previous sittings and only a little more than an hour and a half on this one. Nino was not visibly affected by the additional delay, which seemed intrinsically not of such vital importance as to make the difference between the results of the first two sittings and this one. As for the audience much the same thing may be said. There were more than 20 people present, but there were only two or three more than on both previous occasions. There were some present who certainly made no contribution to the psychic atmosphere and some who might have been charged with an unfavorable effect but the same was true in practically the same measure on both evenings when we got results.

I write this part of my narrative before the sitting of the 21st, to expedite matters with the printer. For that sitting we plan tests which may well settle the thing beyond reasonable doubt. But regardless of this issue or of the nature of our sub-committee's report, we plan to give Nino a few sittings in January before a very carefully selected and carefully limited group just to see what happens. At such sittings there will be no question regarding the suitability of anybody present. As to the time spent in tying that is something else. If the tying is simply a bluff or a meaningless ceremony we can get it over with in a few minutes but if it is to be taken seriously as a check against the normal use of the medium's hands and arms and feet and teeth it must obviously consume enough time to give a thoughtless partisan what he regards as ground for protest.

At this point I may well interpolate some general remarks based on the three sittings so far described. Neither Nino nor any of his controls is supposed to speak any English or to understand any. Nino himself when undergoing Dr Block's psycho-physical examination could not take the simplest command without Dr Vecchio's translation. Eusapia had no better control of our language. In the face of this we got quite often a simple sentence in English from the cabinet—"Oh, yes" "Wait five minutes" and the like. Even more frequently there were indications that English was understood. Thus when the whistle was blown for the first time, I expressed mild concern lest the police respond to the blast and Palladino (speaking in her own tongue) rejoined that if they did she would chase them off. Many mediums to be sure deliver messages in tongues that are strange *to them*, but in such cases the foreign language is always that which is native to the control of the moment. What we got from Nino was speech of which neither he nor his control was capable and understanding of something that neither of them is supposed to understand—a very vital difference.

Even more suggestive was an incident of the second sitting. We were displaying restlessness over the extreme prolongation of the dead end of the seance, and in this connection Palladino informed us that it was 10.54. Inquiry showed that it was really 10.49. The slight error might have been forgiven and the item accepted as significant—had it not been for the fact that at 10.45 Mr Lehmann had consulted his watch and announced the time, quite audibly.

Incidentally, there were at least three supporters of the medium present, and all of them would have ignored this very pertinent fact had they been permitted to do so. Aside from the obvious face value of the incident this willingness seemed to cast grave doubts upon the accounts of the things that Nino does in informal sittings with his friends; there seems no reason to credit his circle with more accurate observation in our absence than in our presence. This is not at all extraneous to the question of Nino's mediumship, as at first glance it might appear to be, for with these very people, and them alone, originates the suggestion that Nino is a medium.

During the second sitting there occurred a violent blast on the trumpet. My secretary, in sewing the gloves on the medium

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had been nearly asphyxiated by the garlic on his breath The trumpet voice, otherwise inarticulate, carried the same message, three male sitters in its path and fairly close were fairly bowled over It seems unnecessary to inquire whether this were celestial garlic on Palladino's breath Nor is this matter a trivial one The trumpet voice is supposed to be independent, and any evidence that it comes from the medium's throat is distinctly pertinent.

At one sitting we secretly introduced an Italian interpreter, who verified without reserve my impressions that in Dr Vecchio's conversation with Palladino there was nothing which he failed to translate

Only two or three times did the voice attempt anything evidential Most of what was tried in this direction revolved about Dr Carrington's previous association with the control she expressed pleasure at meeting him again, remarked that she was now doing herself what the spirits used to do for her etc But there was nothing which Vecchio would not certainly know and through him presumably Nino During one sitting she remarked that Dr Carrington was not present It required more effort to assure one's self that Nino did not know this than to get the same assurance with regard to any other of the control's statements

Some acquaintance with psychic literature was indicated when the control asked (on the first evening) whether Dr Prince were there, and promised that next time Katie King would visit us

Individual experiences had with Nino by Dr Prince Dr Carrington and myself had led to the rather definite suggestion that his trance was genuine so that even if the manifestations were demonstrated to be engineered through normal use of his hands and feet and mouth there would be an interesting question as to whether they were in any sense subjectively psychic As far as our award is concerned we should not have to discuss this question but as a matter of scientific interest we should want to discuss it. From the first therefore we made every effort to collect data regarding the precise character of the trance and it was largely for this purpose that we enlisted Dr Block's aid

Dr Block examined Nino with the utmost care before the first sitting He found him of decidedly hysterical type and extremely suggestible With Nino's eyes fixed upon the point of Dr Block's nose a fountain pen was held in various positions in front of, beside and behind his face His answer to the question whether he could see it or not was almost entirely a matter of suggestion, there was no difficulty at all in getting him to insist that he could see it when he obviously couldn't or that he couldn't when he obviously could Similarly when pins were stuck into his calves he failed to feel any pain when told that he didn't and felt it when told that he did Dr Block was quite certain that he could himself hypnotize Nino with the utmost ease if only they had a common basis of language in which he might address him

On the basis of these observations, Dr Block's opinion after the first sitting was that Nino was in a self hypnotic condition of submerged personality throughout the seance This is another way of saying that his trance was genuine It would mean in simple terms that Nino is thoroughly sold with the idea that when he is tied up put in the cabinet and left alone there in the dark, he goes into a trance—so sold that given these conditions he promptly hypnotizes himself into a trance state He would carry under with him knowledge that in the trance state he becomes Palladino with occasional lapses into the identity of his brother or his mother also that he is expected to do what he can with the physical apparatus provided These suggestions he would apply in his state of altered consciousness and in addition any request which Dr Vecchio might make during the seance would be accepted as a further suggestion, and met if it were physically possible to meet it. Nino's convulsive action after being picked off the floor at the end of this first sitting was regarded as decidedly evidential of the genuineness of his trance

At the end of the series Dr Block was inclined to modify his opinion He was still convinced that Nino was in genuine self-hypnotic trance at the end of the seance, but pointed out that we had no evidence at all of a trance condition *during* the seance. Dr Block applied the usual test of projecting the beam from a flashlight into the eye of the patient, holding the lids open for the purpose. This was done in the presence of Drs. Powers and Stearns, and after Dr Vecchio had begun to bring Nino out of the trance Dr Block was more favorably disposed toward the result than the other physicians. Drs Powers and Stearns objected that the eye-ball was not entirely motionless, as it should have been to make the test an unqualified success. Dr Block urged that under the circumstances, this should not be expected, that it was sufficiently rigid to demonstrate the good faith of the trance. The pupil was conceded by all to have made no adjustment to the bright light thrown upon it

Drs Powers and Stearns agreed that the medium was a hysteric, and even mentioned dementia praecox. In testing out his physical development, Dr Powers a huge person built like Conan Doyle and certainly weighing well over 200 pounds, bore his entire weight upon the horizontally extended arms of the medium and was still unable to break them down or bend them appreciably Nino's chest development is extreme also Houdini was very much impressed with his build and said that Nino had a better physical equipment for escape tricks than he himself

Nino often sits, sealed inside a cheese cloth bag his hands and arms being fixed before he goes in, and the roping to the chair being done outside the bag At Dr Vecchio's suggestion we had planned such a bag for our final sitting and in this connection we had prepared several very effective tests Nino never asserts himself in any way—indeed, in the event of his winning our $2500 Dr Vecchio takes it for granted that he himself will get the money and keep it Accordingly when Dr Vecchio telephoned that Nino refused to sit in the bag I had difficulty in believing that the refusal came from Nino But there it was, leaving us with five hours in which to revise our program

It developed that Dr Vecchio wanted to bring Nino's accustomed gloves and costume, and tie him himself He wanted the chair fastened down again, and to save time he asked that we do this in advance It was thus made possible for the first time, to install electric contacts under the chair with the assurance that they would remain operative We decided to proceed on this basis plus scrupulous scrutiny of the bonds before and after

Dr Vecchio's work was in some respects good, in others poor Over the usual undergarment Nino wore a bathing jersey and long loose trousers of the same stretchable material The jersey was low and loose in the neck but being sleeveless it forced the sewing of the gloves to the undershirt sleeves

The gloves were canvas—easier to get out of than wool and more likely to retain their form while empty but giving less freedom if they stayed in place The arms were bound together at one point only where the wrists overlapped here a wire passed around six or eight times, and was supplemented by a strip of cloth Both were tight, but left the arms as free as those of a pair of scissors with their single bearing point. On the other hand, the whole assembly, in the event of complete escape by both arms would be less rigid while awaiting their return than one involving coat sleeves and a wider distribution of wire On this rock Nino split

Nino's ankles were now tightly strapped together and secured with a padlock—excellent as far as it went but leaving him still to be fastened to the chair In doing this, the ropes were used in excessively long pieces, which were passed and repassed about medium and chair and chair and medium, with effective knots only at the very ends. Even without playing off of slack there was considerable freedom of motion for the arms assembly and the chest

I take it that Dr Vecchio is quite honest in so underestimating the necessity for immobility of Nino's imprisoned arms, and of his chest and shoulders. I am not so sure that it was with good intent that he tried to get Dr Prince and me to give a blanket endorsement of the tying We both felt that Nino could get his hands free only by breaking something but that he had an alarming degree of movement without getting them free. We insisted that we could endorse the tying only after seeing what it looked like at the end, and this Dr Vecchio accepted with rather bad grace.

The seance was slower than usual, 36 minutes elapsing before the first raps. The interval between the raps and the active phase

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efficiently drilling is done by electric drills hauling is simplified and trips can be scheduled more definitely and haulage costs reduced less timber is used roof falls less readily because of speed of progress and in longwall work less working room is required concentration of workings produces large tonnage in small areas inspection and supervision being more effective because of the smaller area kept active cost of track equipment and maintenance is reduced by having fewer rooms or if longwall is provided by having no rooms whatever cost of drainage is reduced by the smaller active area cost of ventilation is lowered for similar reasons cost of plant construction per ton and maintenance is reduced by reason of the larger production per man waste of coal is lessened by larger recovery safety—the most important factor in mining—is increased

In the New Kruskopf Method of Blasting, by which a 30 to 40 per cent saving in explosives is made and as much as 50 per cent more lump coal produced, a long pressure chamber is formed by the expansion of the gases after the detonation of the explosives This result is attained by the use of a fine grained rock dust for stemming The dust is compressed by the explosion and closes the bore hole so tight that a paper sack placed directly in front of the hole is not broken by the shot This long pressure chamber provides the most favorable shearing lines and consequently makes it possible to use a minimum of explosives —*Explosives Engr*, 1 7 pp 181-84

General

The Economics of Trans Atlantic Liners of Various Lengths forms the subject of an analysis which leads to the conclusion that for the greatest return on investment today the 600 foot ship is the logical choice a vessel of this length giving about seven per cent per annum return on investment If a return on investment of about 3 per cent would be sufficient an owner would be justified in designing building and operating a vessel of 700 foot length The construction and operation of any vessel having a length exceeding this cannot be justified from an American private owner's point of view under existing conditions There are very few trips in the year when the 900 or 1000-foot ship will approach capacity in passenger carrying performances and during the rest of the year these vessels will not carry any more passengers than say, the 600 or 700 footers It may therefore be said that world conditions will have to improve very materially before the 1000 footer is an economic probability for either a European or American company although less so for the European —*Marine Eng and Shipping Age* 28 13 pp 759-63

The All-metal Hull for Flying Boats is anticipated as a standard future design according to a writer in *Metal Industry* The problem of duralumin aircraft construction had been approached in various ways by different European and American constructors with more or less success It seemed to the engineers after studying the situation that the mistake most generally made was that of using too thin metal yet the machines designed with this thin metal were always comparatively heavy Upon further analyzing the situation it was decided that the reason for this was the fact that the skin or plating was used for covering only and in most cases was not employed as a strength member It was determined in the aeromarine hull construction to use a thick enough skin so that it would not be easily damaged and to make this skin take the loads imposed upon the structure, the interior bracing or frames and longitudinals being used as stiffening members only to carry the loads to the skin Accordingly in the hull proper it was decided not to use any metal thinner than 040 To the surprise of all concerned it was discovered that the assembled figures indicated a structural weight lighter by 100 pounds than the weight of a similar wooden hull The problem of water tightness was overcome by the use of canton flannel and asphaltum interposed between the thicknesses of metal There seems to be little question but that this alloy flying boat hull construction is here to stay and it is only a matter of time before all aircraft will be built of metal as is the railroad equipment of today and that this metal aircraft will be as far superior to the old type wooden planes as the new steel Pullman coach is superior to the old wooden passenger car —*The Metal Ind.*, 21 12, pp 471-73.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

A Low-Priced Loud-Speaker—$10 list—has lately been placed on the market by the manufacturer of well known head 'phones. This loud speaker is of neat construction and is said to have a clear, resonant, mellow and realistic tone Requiring little more power than the usual head set, this loud-speaker can be used with the usual receiving set and two-stage amplifier

Long-Distance Reception with Crystal Detector is reported by Frank Heinfling, radio officer of the steamship "Californian" With a galena crystal detector, Mr Heinfling intercepted the NAA station at distances of from 3500 to 4100 miles Confirmation of these results has been had from the Bureau of Navigation With a Telefunken type E-266 single-bulb set, Mr Heinfling copied the German station POZ at a distance of 5500 miles and also received music broadcasted from WOC of Davenport, Ia. in the Pacific some 2500 miles away This receiving set makes use of an arrangement which does away with the filament and "B" batteries.

Many So-Called "Bootleg" tubes are now appearing on the market and are being offered at lower prices than the standard tubes. Furthermore, in general appearance these tubes resemble quite closely the standard tubes, and are said to have the same operating characteristics It would seem that the independent tube manufacturers, despite claims to the contrary, could not produce tubes of the thoriated filament type, with extremely low current consumption characteristics, because of the inherent difficulty of making the special filament. Reports from users of independent tubes are generally to the effect that these tubes are not as satisfactory as the standard tubes

The Myers Tubes—those characteristic tubular vacuum tubes with red and black ends, fitting into clips after the fashion of the usual cartridge fuse—are now being made in Montreal, Canada, and may be obtained from some dealers or by mail These tubes have long been known for their high efficiency, especially for audio frequency amplification and radio frequency work. At present the Myers tubes are being made in two types the dry battery tube 2½ volts and one-quarter ampere and the universal tube which operates on either three dry cells or storage battery The tubes are now coated with silver instead of being furnished with clear glass as in the past

***Run-Down "B" Batteries* are often the** cause of unsatisfactory results with a receiving set. The best manner to test out "B" batteries is by means of a voltmeter with a reading of 25 volts for testing out 22½ volt units, and a reading up to 50 volts for testing out 45 volt units. Electrical instrument manufacturers have not been slow to realize the need of inexpensive voltmeters for this purpose, with the result that such meters may now be purchased for as little as $2.50 One manufacturer has developed a special meter which may be placed in the usual peep-hole of the radio panel, and which serves to give the "B' battery voltage or the current consumption of the filaments

Capacity Shields have been widely used in the past for eliminating or reducing the troublesome capacity effect in regenerative circuits. It is now claimed that capacity shields should not be employed, in that they decrease signal strength and broaden the tuning Instead, the builder of a radio set should see that all instruments in the tuning assembly such as coils, condensers, variometers, variocouplers and so on have the side next the panel and the shaft side connected with the grounded side of the grid battery circuit Audio-frequency transformer cores sometimes need to be grounded Manufacturers of regenerative sets generally do away with shields by placing the inductance units some distance away from the panel, and using insulator couplings between the dials and the instruments.

Directed Radio Waves for broadcasting are predicted by Marconi himself. As the result of numerous experiments with directed radio waves, Marconi has come to the conclusion that this method of communication is not only highly practicable, but that it must bring about far greater efficiency. In collaboration with C S Franklin, the great inventor recently communicated over a distance of 2250 nautical miles with considerably less expenditure of electrical energy than is generally used. Marconi has been led to believe through his recent successes in directed radio, that owners of crystal sets in the United States will soon be enabled to receive messages broadcast from London, because all the radio energy will be sent out in one direction thus intensifying the signals in receivers lying within that beam.

Short-Wave Relay Set.—Again the General Electric Company has scored a marked advance in radio broadcasting, this time in the form of a short-wave relay set which may be transported to the scene of church services, banquets, dramatic performances, and so on Instead of depending on a telephone or telegraph line between the scene of activities and the transmitter of the broadcasting station, the present set transmits the radio program to the broadcasting station, where it is picked up, amplified, and turned over to the usual transmitter to be broadcasted to radio listeners. The short wave relay set broadcasts on such a low wave length that it cannot be intercepted with the usual receiving set. It is said that this rebroadcasting arrangement does not affect the quality of speech or music and that listeners have been unable to detect the use of the short wave relay set in place of the usual wire link

A New Type of "B" Battery developed by the engineers of the Burgess Battery Company marks a distinct innovation in such batteries This battery has dimensions and weight which coincide exactly with the standard No 6 dry cell commonly used for filament current. The new battery is a 22½ volt "B" battery It is 6 inches high, with a base 2½ inches square. The terminal connections are brass binding posts at the top By an ingenious method of construction the fifteen cells, individually insulated, are placed in a vertical position in two inner compartments These compartments are arranged one above the other, and the whole is enclosed in a non metallic, non inductive waterproof container The electrical capacity of the battery at two milli-amperes is about 500 hours, which places it in the group of so-called medium-sized "B" batteries.

The Importance of Good Insulation is not fully realized even at this late date Manufacturers of inferior apparatus and sets still make use of wood as a support for instruments and terminals. They even go so far as to give a wood panel or base a coating of nice black paint, so as to convey the optical illusion of good insulation However radio-frequency currents are not deceived by black paint and, if anything, such paint causes greater leakage than ever Receiving sets should be insulated with the greatest care. Only bakelite or similar material, as well as hard rubber, should be used for panels and for terminal blocks or strips. The antenna circuit, too, should be carefully insulated. It is surprising how elusive radio frequency currents can be Even insulated wire will not keep radio current in place, so that glass, porcelain or composition insulators should be freely employed. Otherwise, a marked decrease in efficiency is found to take place, especially in damp weather

The Neutrodyne Receiver is steadily growing in popularity, because of its selectivity, its far-reaching scope, and its utmost simplicity The usual neutrodyne set has two stages of radio-frequency, a detector, and one or two stages of audio-frequency amplification, making a total of four or five tubes. Only three controls are used, two of which do most of the work while the third clarifies and strengthens the signals. In the correctly constructed neutrodyne receiver, there is no distracting whistle or distortion The remarkable feature of the neutrodyne receiver is that the same stations will come in day after day with the same adjustments of the three dials, so that the user merely has to chart the various stations according to the readings of the three dials, and from that

time on the stations can be tuned in by simply setting the dials to the chart numbers. As for selectivity, the neutrodyne, operating in a congested radio section such as New York City, readily tunes out nearby stations to pick up long-distance stations. When it comes to distance, a properly constructed neutrodyne receiver in New York City will pick up the Pacific Coast broadcasting stations at night as a fairly regular performance.

Furniture Radio, so called, is becoming more and more popular Virtually all the leading radio manufacturers are now turning out radio sets made in the form of attractive furniture. Thus the self-contained and attractive furniture radio set is finding its way into the living room of the finest home, instead of being relegated to some odd corner as in the past, when it required mussy storage battery, a mass of "B" batteries, and a mass of unsightly wires. The furniture radio move is an excellent one and will no doubt do more to give radio a definite place in the home than anything else However, there is the ever-present danger that furniture radios may become more furniture and less radio That is to say, there are already ample signs that the radio end of some furniture radio sets is not what it should be Too much attention is paid to making the set look attractive, and too little to radio details Furthermore, the wish is often expressed by the public that the manufacturers of the highest grade and most efficient radio sets put their highest type radio sets into furniture radio form. After all it is the radio set proper, and not the beautiful Jacobean period cabinet, that brings real pleasure into the home

Standard Frequency Tests.—The Bureau of Standards is transmitting special signals of standard frequency about twice a month. The signals can be received and made use of with the average receiving set in the general territory east of the Mississippi These special signals are of use to testing laboratories, transmitting station operators and others in checking wave meters and adjusting transmitting and receiving apparatus The accuracy of these special signals is better than three-tenths of 1 per cent. All transmissions are by unmodulated continuous wave telegraphy A complete frequency transmission includes a general call, a standard frequency signal, and announcements The general call is given at the beginning of the eight minute period and continues for about two minutes This includes very long dashes with the call letters WWV intervening The announcements are on the same frequency as the standard frequency signal just transmitted, and contain a statement of the measured frequency An announcement of the next frequency to be transmitted is then given There is then a four-minute interval while the transmitting set is adjusted for the next frequency The schedule indicates that signals will be transmitted from 11 P M until 12 32 A M Eastern Standard Time, on January 21st, February 5th and 20th.

Interference is on the increase, especially in the New England and Middle Atlantic States. Indeed, evening after evening radio programs are seriously marred by radio telegraphic interference. It appears that the greatest interference comes from certain ship and shore and Navy radio telegraph stations employing the 450-meter wave length, which falls in the middle of the broadcasting wave length range. The Radio Club of America, the pioneer radio amateur organization of the world, has taken up this matter and is exerting every effort to put an end to the present very unsatisfactory state of affairs. Two operating companies have been using the 450-meter wave length and causing serious interference with radio programs One company has indicated its willingness to abandon the 450-meter wave length, provided its competitor do likewise Another source of interference is from the shore stations operated by the Navy Steps are now under way, with a view to having the commercial stations as well as the Naval stations abandon the widely tuned damped radio transmitters in favor of the sharply tuned continuous-wave transmitters. Another source of interference is the re-radiation of regenerative sets in the hands of inexperienced or careless operators. In truth, this interference is the most serious of all, for one "ham" operator can, with a regenerative set, spoil the programs for other receivers scattered over a wide area. Gasoline engines cause considerable interference, because of the spark ignition which sets up radio waves. Arc lighting is also a prolific source of interference.

Our Psychic Investigation Advances

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was also longer—20 minutes. The active phase lasted 13 minutes and was the most brilliant we had had I describe only the items not previously experienced. The map of the third sitting applies equally to this one

There was a great deal of what Dr Vecchio described as blowing upon the curtains and blowing of them out into a bulge. Most of us took this to be rather stroking and pushing with the trumpet It was very violent ultimately the table was upset in a spasm of this sort

After prolonged ringing one of the bells was pitched out of the cabinet. Palladino specifically named Dr Vecchio to pick it up and thrust it inside the curtains as it was taken from his hand, this was gently slapped giving him the same impressions that he would have got from a flesh and blood contact He asked that my hand be dealt with similarly and Eusapia promised but under continued reminders she failed to make good

For the first time we got hand clapping from within the cabinet for the first time (see below) there was reason to suppose that both Nino's hands were free

Tailing off was much as in previous sittings A violent outbreak was followed by peace with Palladino speaking more frequently than before She began to promise us apports and all sorts of wonderful things I whispered to Mr Lescarbourn that this orgy of promises was a sure sign nothing more would happen Dr Vecchio seemed to know it too abandoning his close watch of the cabinet, he swung about in his chair and engaged in animated conversation with an Italian visitor behind him Ultimately he began to ask Eusapia if we might terminate the sitting and after the ringing off process had run for 37 minutes he got her affirmative answer

Now at all seances there is delay at the start, to get the forces going, and at the end to get them toned down so that the control may safely leave But with a high grade medium I have never had these intervals run into such major fractions of an hour as with Nino and never seen such complete suspension of activity I think it fair to say that this strongly suggests the long and difficult processes of escape from the bonds and return thereto Particularly objectionable is the wait of from 40 minutes to an hour after everybody realizes that speaking practically the seance is over

Entering the cabinet to examine the bonds we found wires and ropes substantially undisturbed with one important exception Loops that had passed about the chest and upper arms were now down at waist and elbow respectively where they would hamper movement neither of the parts above these joints nor of those below Initially they were not loose enough to have fallen down unless greatly stretched by violent straining That this could have been done was indicated experimentally a six inch piece of the rope was lengthened half an inch by one vigorous pull of the hands This rope incidentally was one of the things brought in by Dr Vecchio

When we came to the medium s actual garments one sleeve of his undershirt was spiralled about his arms like a sock that had been twisted in being pulled on making two complete turns between wrist and shoulder This gave the strongest possible suggestion that he had been out and in again—I know no other way in which it could have been so twisted in fact The other sleeve showed about three quarters of a full turn The body of the shirt was entirely unbuttoned, the buttonholes showed indications of having been violently wrenched rather than opened naturally and at least one button had been yanked off to be found on the floor The right side of the shirt was substantially in its natural place over the medium's chest, regarding the left wing little could be seen with the jersey in position other than that it was seriously displaced

A move to investigate this further afforded the first visible indication of our interest in the shirt It was met, without the slightest warning or premonitory symptom, by what was plainly meant to be taken for a violent epileptic fit. Dr Stearns stated categorically that the attack was not epileptic, at least two essential symptoms being absent and at least one irreconcilable one present. It was purely hysterical, consciously or subconsciously, the fact had been noted that examination was about to trespass upon critical

ground—and the means available were used to prevent this.

Prevention, however was only temporary. While Dr Vecchio and his secretary calmed Nino we took the liberty of eavesdropping. We were rewarded by noting that part of the "calming" process consisted in putting his garments in order. We learned that a substantial fraction of the left side of his shirt was reversed into a sort of balloon effect and jammed down the left sleeve along with his arm. We noted that the safety pin which had originally joined the jersey and the undershirt, in the middle of his back, having lost its grip on the jersey but kept hold of the shirt, was salvaged from the neighborhood of his elbow. We said nothing about all this—and neither did the doctor. It is not the first time he has connived in the attempted suppression of evidence unfavorable to his medium.

The canvas gloves were wet on the outside, where the perspiration with which the medium was liberally anointed could not have penetrated. We also found teeth marks on the canvas. The bells, which alone of all the apparatus were well suited to the reception and preservation of the finger print, showed a liberal sprinkling of these—as apparently they always do when it is believed that the medium has been able to free a hand.

At the beginning, the second chair with the apparatus was 21 inches from the medium's knee. At the end it had been moved to within 10 inches. The tell-tale light in the next room had never flickered, proving that at no time had Nino taken his weight out of the chair. We have verified experimentally that tied as he was at the end, but with both arms free, he could have got possession of the other chair without contradicting the evidence of the lamp. We have verified that under the same conditions he could do everything that was done. He would have to exercise a little ingenuity in the manipulation of other objects with the trumpet, but that is all. In order for the impossibility of moving the medium's chair about the cabinet to be significant, the two chairs would have to be separated by a full yard at the very most.

More generally, everything that was done at any of the four sittings we can do, given the degree of freedom which the present narrative suggests the medium had in each instance. The members of the committee and their outside consultants are unanimous in feeling, not alone that no evidence is presented of the genuineness of the manifestations, but equally that good evidence is presented for regarding them as having been produced by normal use of the medium's anatomical apparatus.

As to Nino's trance, no such complete agreement exists. Dr Block is strongly impressed with the fact that, whatever we know about his condition at the end, we have no evidence at all regarding his condition during the sitting. He feels that for one in actual trance, clean-cut faculties of association would be impossible—in this respect the person in trance ought to be like the dreamer, who associates familiar and unfamiliar things in the wildest and most absurd ways without ever realizing the absurdity until he wakes. The derangement of the associative faculties here implied, which Dr Block thinks ought to exist in

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Remolding Our Civic Clay

(*Continued from page 90*)

each part of each property, heights of the buildings on it, their front yard and set-backs, widths of side yards, number of families in each building, home occupations, street widths, grades and pavements, and trees. The nature of this data and the immense amount of time and thought expended on it go to show that city planning has indeed become a profession and that everything under the sun that pertains to the work is critically analyzed. Decisions are not left to "I guess." Instead they follow directly from the study of the premises. They are like solving for x—there is one answer and you get it.

From the 400 little maps a map of the whole city was drawn on which the existing use of each building was classified by color. This map showed at a glance the extent to which zoning without any directed efforts already existed. A similar map showed in a corresponding manner the classification of buildings according to heights, setbacks, yards, lot widths and lot depths.

It would appear that in doing all this detailed work the city planners were earning their forty thousand dollars. These maps

and the zoning ordinance that followed from them had to be based on a scientific study of conditions, land values, methods of construction, local fashions in building and the building code in order to make up a common sense protection of property and give minimum hardship to individuals

The zoning maps, now in tentative form, indicated each building which was contrary to the zoning ordinance for the district in which it found itself located, by special colors and symbols, so that they stood out. The districts were then readjusted so as to reduce to a minimum the instances of non conforming buildings. The function of the city planner working on an existing city is not to make a perfect plan for that he seldom can do but to make one that comes only as nearly so as is reasonable, considering that changes cost money

The Planning Board of the City of Springfield next held conferences and went over every detail of the ordinance and map They further made trips into the city to study the matter on the spot They wished to assure themselves that no consideration had been overlooked The people of the city studied the ordinance and maps and discussed them with the Board Several months were thus given to their consideration, for the Board wished to be sure it was right before it went ahead The care given to the work and the time allowed for free discussion were an assurance that the city had looked before leaping

Then the Board adopted the ordinance, presented it to the city council informally for revision then formally after revision It was printed and set before the public 30 days and finally passed and became a city ordinance

But zoning was not by any means the only work done for Springfield Fully as long and painstaking studies were made of the city traffic Maps were made and reports compiled Again lengthy studies were made on the subject of railroad stations and track relocation also on the matter of trying to provide an adequate public school athletic field

All of this work was done in a careful thorough and often plodding manner in order to assure a scientific job The city planner did not have to begin exactly at the bottom of the pile however for he brought to Springfield the invaluable experience he gained on doing many similar jobs for other communities Instead of attempting to settle its own problems Springfield called in expert aid from outside And despite the fees the city planners thus earned, Springfield without a doubt saved money

One Law versus Forty-Eight

(*Continued from page 96*)

tion and several of party control His department is thoroughly on its toes in every respect but the code under which it has to operate is a fearful and wonderful mess There are two separate organic Acts, the "Traffic Act" and the "Motor Vehicle Act." Presumably because the former is older and was originally self sufficient, lots of things are found in it which one would expect to find in the other and, for some reason less clear the reverse is also true There is absolutely no way of guessing in which of these two Acts a desired regulation will be found

This would be bad enough, but it is made worse Both Acts are printed in the one pamphlet *each followed by its own index* The index to the Traffic Act falls at the physical end of the book, and it is sufficiently large and imposing to pass as complete Only after having riffled the pages and discovered by accident that there is an other index in the middle of the book, at what turns out to be the end of the Motor Vehicle Act, does one learn the double-barrelled character of New Jersey's motor code and suspect that the single index at the rear of the book doesn't cover the entire ground Until one makes this discovery, it is obvious that important provisions of the law are more impossible of location than if the book had no index at all—they are, apparently quite missing. Incidentally, the two Acts taken as a whole are miserably codified, overlapping repeatedly, so that no indexer in the world could make their contents easily accessible. When one has learned the peculiarities of this booklet, one feels obliged, even after finding an item in one Act, to scan the index to the other for further enactments on the same subject.

In skilful codification of the law plus skilful indexing, the Missouri pamphlet has a clear lead over all the others. Vermont and Massachusetts show admirable indexing

of a poorly codified mass of law The New Jersey indices, for that matter, taken individually, deserve the same compliment.

The Michigan pamphlet deserves a special paragraph of commendation—mingled with some regret that the chap who did such a good job didn t incorporate a few obvious betterments. The existing motor code of this state consists of a large number of sections from the codified general laws of 1915 plus various amendments plus a quantity of separate and additional acts passed at various dates since 1915 The booklet is compiled in the office of the Secretary of State and instead of *merely stringing* the additional laws along chronologically the compiler has endeavored to put them in a logical order Barring the fact that the logical place for some of them is somewhere in the middle of the matter abstracted from the 1915 code, while he has placed them all after this material he has done a good job and he has supplied a very fine index that makes the whole content of the code *extremely* accessible. Where the sections of the 1915 code have been amended note is made of this with reference to the year and number of the amending act, which is admirable except that it leaves one with the suspicion that the amendment has *not* been incorporated into the text, and with no way of disproving this save by searching the latter half of the booklet and noting that none of the cited amending acts appears there But where this pamphleteer has fairly created a standard for all other codifiers of motor law to follow is in the insertion after various sections of the law, of citations to cases and official opinions bearing upon the preceding text *Most of these are Michigan decisions* but a few come from outside the state Some are so complicated that the pamphlet man has not attempted to summarize their import, referring to them merely by name and date most of them are sufficiently simple so that he can indicate what bearing they have upon the text of the law The entire booklet contains 94 such citations, and its value is increased by them beyond all estimate

A number of the motor code pamphlets carry on the first page or two a display of the more vital features of the code, in quick and snappy language of some sort This is probably a good feature, though it might be argued that it diverts attention from the *provisions of the law—necessarily numerous*—which are not thus displayed

Well let us suppose that through some millennial chance all our States should codify their motor laws properly publish them in attractive pamphlets skilfully indexed and placard them after both the Connecticut and the Pennsylvania schemes Effort to aid the motorist could go no further yet it would not have *gone far enough* An American driver of years' experience can after a short stay in England, force himself to drive on the left of the road but unless he stays in Great Britain for a long time he will have narrow escapes, suffer horrible scares especially at night when he sees lights hurtling toward *him on his* 'wrong side and he will be responsible for scaring a lot of eminently correct British drivers out of their seven senses—all without becoming a finished left hand driver If he stayed long enough to become this he would have to go through the whole business again, on returning to a right handed country

Between no two of our States is there *any such glaring single point of motoring* divergence as there is between England and the rest of the world in the choosing of the side to drive on But even so and just so in the smaller things that are differently regulated in our different States and municipalities one cannot pass instantaneously from one set of reflexes to another Yet instantaneously one crosses State lines and city boundaries, and is called upon for this shift. It can t be done without some fumbling and some reversion to the more familiar customs and of course the greater the emergency the more probable this reversion All the printed matter and signboards in the world won t prevent an old and ingrained habit *from* asserting itself And when one carries across the line the habits that should be left behind, one becomes at best a source of annoyance, and at worst an active element of danger

The root of the difficulty then lies not in the ignorance of the motorist, not in the difficulty of informing him but entirely in the fact that, within the territory covered by the *average motorist* there *exists a* plurality of motor codes If, confining our attention to this angle, we ask why such plurality should exist, there is but one answer—there is no reason why it should There is, of course, a reason why it *does* exist

—48 different legislatures, in 48 different States, have been passing traffic laws, each with no reference to what the others were doing Evidently this must lead to approximately 48 different ways of doing the same thing The conflict is not deliberate, it has arisen automatically

Unfortunately, it can't be eliminated automatically Elimination must be a matter of deliberate and considered action And unfortunately, elimination cannot proceed merely by persuading the individual State legislatures to stop enacting new traffic laws on their own motions and their own responsibilities and their own judgments as to what is proper This would be a pretty large order of itself but to remedy the situation that now exists it would be necessary to reopen a lot of closed business and induce the individual legislatures to repeal or seriously modify much old legislation This, obviously is an even larger order One might hesitate to try to fill it, were it not so very clear that such failure will bring us to more grief than we could possibly get out of an attack upon the problem How then, is such attack to be made?

Of course no club can be held over any State nor anything that *suggests* a club Legislators are notoriously sensitive about their prerogatives and it might seem that with all the matured deliberation and all the *engineering authority in the world* the prospects were pretty remote of getting a large number of independent legislative bodies all serving distinctly local interests and all hardened in local viewpoints to agree upon the same measures Experience contradicts this pessimistic attitude

The Motor Vehicle Commissioners of 12 States—New England the Middle States, and Ohio—got together not so long ago and with the expert advice of the Automotive Society and the Illuminating Engineers they worked out a standard for headlights that was designed to combine maximum illumination with freedom from glare Coupled with this was the utterly revolutionary proposal that the States should set up official testing bodies examine all headlight assemblies and publish a list of the trade-*names and the manufacturers of all those* which complied with the standard set up by the conference Finally a law was to be asked from each State legislature adopting *this standard* as that of the State, and barring all unlisted headlights

Now here is everything that a narrow minded and suspicious person might be expected to object to and everything that a legislator might fear even if he didn t himself object to it There was the strong suggestion of domination from without the State there was the element of submission to expert advice so often the anathema of politicians there was the placing of a State wide monopoly over an essential article in the hands of a limited number of manufacturers there was what might be construed as advertisement of this monopoly and *these manufacturers at State expense* Yet so obvious were the advantages of the new standard itself so enormous the advantages of a uniform headlight law for 12 States forming a solid geographical block so complete the authority of the technical bodies whose engineering advice had been had that in no instance has there been difficulty in getting the legislation through Any motorist in any of these 12 States may now drive freely through the other eleven without a thought for the question—always before a veritable Chinese puzzle—whether his headlights are legal In precisely the same way, through amicable conference between the responsible heads of the State traffic and highway bodies plus such engineering organizations as may be able to aid in each instance it ought to be possible to *get uniform legislation on any other points* to replace the present hodge podge

One danger must be avoided What we have outlined involves asking many States *to change their laws in many details* We dare not do this hastily If after our request has been met by the States it turns out that the uniform law thus obtained is not workable or is not the best way of gaining the end at which it is directed or perhaps is not even a proper way of doing this, it is going to be far more difficult to get agreement a second time from the legislatures that have been thus victimized once A definite authoritative, orderly procedure needs to be set up for deciding just what provisions a standardized motor-vehicle law should contain, and for resolving the very ticklish question of what values should be *assigned to speed* limits and other things that require numerical determination Only with such procedure is it thinkable that State legislatures would be sufficiently impressed to enact identical standardized provisions, unspoiled by spontaneous amendment.

It would not be so simple in all directions as it was in the matter of lighting. What to do at a railroad crossing how fast it is safe to drive at a given point, how best to dodge the patrons of the street car—these are questions on which the layman feels that he has an opinion which he can match with the pronouncement of the expert much better than he could in any such recondite *field as that of headlight standards.* Agreement on many of these items could be reached only after prolonged general discussion, with an attempt to educate those whose views appear destined to hold a minority position Assurance that the best solution had been attained would in many instances require a comparable process.

But the thing ought to be feasible It ought to be possible to block out a standardized traffic act covering all the ground that such an act ought to cover—defining, in fact, this ground In many respects, such as the fixing of licensing fees, it could be only a blank form, to be filled in in detail by each state In many other respects its whole value would consist in the expectation that it would be adopted, without changing a line or a figure, by every state Such adoption *could very well come piece meal, by gradual* amendment of existing codes, or where it turned out possible to convince any state legislature that the entire motor code of the *state was in need of revision* and recodification, the standard code could be presented, with the hope that it would be adopted without amendment If this were not realized, at least it could be accepted in its substantial framework greatly simplifying the subsequent work of uniform codification and of securing further uniformity of the text.

Our articles of January and of this month have been destructive in the general trend of their criticism—they have been devoted to showing how hopeless the present conditions are and how imperative it is that remedy take the form of standardized motor legislation Future articles will take up the constructive side. We shall *display and compare* specific provisions of specific state codes, suggesting the best We shall inquire what ought to be included in the law and *what omitted We shall seek suggestions* in the code of each state for laws which could advantageously be applied in all.

And we shall hope most fervently that we shall not have the discussion all to ourselves We encourage opinions and arguments from our readers Write now and tell us what you think ought to go into a uniform traffic law write later on and criticize the specific suggestions which appear We hope to make the SCIENTIFIC AMERICAN an open forum through which this important matter may be discussed and much of the preliminary work effected of clearing the ground for uniform motor legislation throughout the country

The Romance of the Lock

(*Continued from page 79*)

they might contain He did not want to injure the safes for there was a chance of acquittal Accordingly the makers of the safes and many other experts employed by other safe manufacturers were summoned and did their best They tried this and that and the other, but they could not 'feel out' the combinations

Biancolo read about these unhappy proceedings in the newspapers One morning he strode into the office of the district attorney pulled off his overcoat and announced that he d like *to see what he could do with* the safes He bent down over the first one and went to work He did not sensitize his fingers, to be sure Indeed, he did not trouble to wash off the grease and grime of the workshop Instead he began slowly rotating the dial back and forth, feeling carefully, with an ear pressed against the safe door, listening with great intentness From time to time he stopped, scratched his head and seemed to be calculating Five minutes he worked away ten minutes, fifteen

The experts stood about in a grinning and contemptuous group. One or two were guilty of invidious remarks and condescending laughter Biancolo paid no heed For five minutes more he went on turning the dial delicately in the tips of his fingers. Suddenly he straightened up, twisted the handle of the safe and swung the door open

The gentlemen who had nobly failed to do this very feat grew shame-faced or open-mouthed They waited to see this wonderful fellow open the second safe in about five minutes and then departed without comment

Later on, I talked the business over with

the safe opener and found that he was in the habit of doing just this trick and made a good living at it from the numerous persons who annually mislay or forget the combinations to their safes. He had done the thing several hundred times. He seldom failed. Indeed, I had occasion to send him, at a subsequent time, to a well known lady who had lost the combination of her safe, and he got the thing open in a few minutes, without fuss or ceremony

Biancolo explained his method of work to me as one reveals a secret without revelation It is, however, quite plain that he uses a combination of the tactile and auditory senses plus a wide and accurate knowledge of combination locks. If he manages to get the first number, he never fails to arrive at the rest, usually by a simple method of deduction based on long experience and well known facts about combinations that I had better leave unstated It may be well to note that the combination locks he has opened, to my knowledge, were all those of office safes or ordinary vaults. Whether he would succeed in the case of a thoroughly modern bank lock I cannot pretend to say

There is, however, another method by which the combination of any vault may be opened if the burglar has opportunity to get his data in advance Indeed, this plan of action was used in one of the great bank burglaries in New England in the last generation If my memory serves it was the famous burgling of the Northampton bank, but I cannot be sure.

Near the closing hour one afternoon a well dressed, respectable looking stranger presented himself to the officers of the bank and handed in his card, which bore the imprint of a great firm of safe builders and the name of the caller with his title as one of the officials The bankers admitted him cordially and he began talking with them about their vault He did not make a direct sales talk but said he was visiting among the banks of the vicinity to study the various vaults and see whether any of the banks were in need of better equipment or changes in their locks There had been a number of big burglaries in New England and the bankers were glad enough to let the expert examine their equipment

Accompanied by the cashier, the visitor went to the vault door which stood open, and turned the bolts with the handle so that, had the door been closed it would have been locked save for the mixing up of the combination He then took hold of the knob of the dial delicately with the tips of his fingers and turned it slowly to the left until he felt the first tumbler in position He then shifted it a trifle further to the left and reversed the knob turning to the right two turns and again carefully feeling the second tumbler into its place He now shifted this tumbler a little further to the right and reversed again for the third tumbler Having found this he carelessly turned the handle and saw that the bolts were released He then mixed up the combination in an offhand way said that the lock was an excellent one and in fine repair and went his way after a few compliments

The bankers felt after the pleasant call of this well informed gentleman that they had no reason to worry Had he not said that their vault was above suspicion? Alas, there was a rude awakening The bankers came down to their rooms one otherwise pleasant morning to find that the combination had been opened as if by magic the chest entered by means of keys and explosive and a huge total of cash and bonds abstracted Suspicion fell on employees on officers, on everyone but the civil gentleman who had called a few weeks before It was only when the safe makers were summoned and disclosed that there was no such person connected with their company that eyes were turned in the correct direction

The visitor had, in fact, been one of the master burglars of his day While he had stood at the vault door, chatting pleasantly with the cashier and apparently examining the lock, he had really got the numbers of the combination and noted them mentally When he turned the dial left and felt the tumbler in place he took the first number, and so with the second and third He could, of course, not have done this had the dial been in the locked position when he began his work.

The gullibility of the cashier of that old bank, long ago, cost his institution more than half a million, and bankers ever since have been careful to see that such a trick be not repeated—by a plausible stranger or by someone on the inside.

Our Psychic Investigation Advances

(*Continued from page 139*)

Nino's trance if the latter is genuine certainly was not observed But Dr Prince while granting the validity of the analogy between hypnosis and sleep for ordinary subjects, feels that Nino is not such a one and that in his case Dr Block underestimates the possibilities of long practice Nino has been in trance literally hundreds of times and Dr Prince feels that he has acquired an educated subconsciousness, a sort of genius for trance, of which the ability to associate ideas is merely one aspect. If I am privileged to form an opinion on this very abstruse subject, I should be inclined to support Dr Prince's views of the possibilities of oft practiced submergence of consciousness

All opinion save Houdini's is that Nino was in a valid trance at the end Dr Prince regards this trance as extending throughout the sitting There is no question but that Nino is sufficiently hysterical and sufficiently suggestible to hypnotize himself into going in trance and impersonating Palladino and attempting to work with the apparatus In such a trance, any suggestion put forward by Vecchio or any other sitter would be seized and acted upon if possible and consistent There is no question that if this is what happens Nino will struggle with the bonds until he gets free or is exhausted in the attempt to execute this suggestion—equally whether it is auto hypnotic or comes from outside The attempt to prevent examination of the incriminating under shirt it is to be emphasized is in no way contradictory of this theory—this could be done subconsciously quite as well as consciously and indeed is exactly what would be expected from one engaged in subconscious fraud

The subcommittee in charge of Nino's case consists of Drs Prince and Carrington and Houdini, and the opinions of Drs Block and Stearns receive so much consideration that these gentlemen might almost be regarded as voting members of the subcommittee If this body were obliged to report finally upon Nino's mediumship at this time they would feel that the only possible verdict was one of subconscious fraud and they would feel that the facts cited in this narrative were sufficient to support such a verdict At the same time they feel that they have not exhausted the scientific interest of the case and they would be quite willing to sit further and to withhold their verdict until after such sittings The suggestion for further sittings came originally from Dr Vecchio at a time when he had expressed dissatisfaction with some of the conditions prevailing at the series here reported The committee will regard such sittings as in the nature of an appeal against the verdict indicated above—such appeal is provided for in our conditions as promulgated in our issue of January 1923 In justice to the medium therefore no formal and final statement by the committee is made pending the issue of the new sittings

The Heat of the Earth

(*Continued from page 98*)

well a cable is necessary that used in the above tests consisting of a steel aviator wire and two enamelled copper wires each inclosed in a double thickness of cloth insulation Cable of this kind weighs 20 to 25 pounds per 1000 feet and is lowered and raised by special hand operated machinery For lower depths than 1500 feet the use and handling of this kind of cable becomes rather too expensive and a mercury thermometer of the maximum type has taken the place of the electrical resistance instrument Usually two or three mercury thermometers are lowered in the same tube or bomb so that a double check on the readings may be obtained Every care has to be taken to keep these maximum thermometers upright and to prevent their knocking against the side of the hole when they are being drawn up In summer, when the temperature at the top of the ground is much higher than in the first two or three thousand feet of the well the thermometers have to be cooled with ice before being lowered Fortunately for the convenience of the measurer using these maximum type instruments the temperature invariably increases with greater depth and never falls lower, whatever the rate of increase may be

In mining operations the increase in heat as the lower levels are reached has long been one of the problems with which mining companies have had to contend, not only because of the discomfort of the mine workers

but also because of the danger of accidents when the combined heat and pressure have reduced the alertness and carefulness of the men. In the deepest mine in the world, the St. John del Rey gold mine in Brazil, which has reached a depth of 6726 feet below the top of the ground, the problem became so acute some years ago as to threaten the closing down of the mine entirely The men became sluggish and dull and more and more careless in taking precautions Accidents increased until the death rate averaged more than one a month, and it began to be difficult to get not only laborers but skilled professional workers as well to go to the bottom levels. The problem was solved by the building of a cooling plant at a cost of nearly half a million dollars, which drives air into the shaft at a temperature as low as 43 degrees. Even with such devices as this, however, mines in many parts of the world would have difficulty in operating at this depth, as the rate of increase in temperature in the Brazilian mine has been only about one degree in 125 feet.

With Camera and Chisel

(*Continued from page 106*)

of one marking to fall directly upon that of the other, the surface thus receiving the light will occupy the same position as the corresponding surface of the model or subject, when the photographs were taken. Thus it may be seen that by building or carving the material until the corresponding markings of screen and record photograph coincide over the whole surface, a true reproduction of the form of the subject will be the result. The work of modeling or carving is done by hand under the guidance of the projected light beams, which carry the true form of the subject to the sculptor, but there is nothing in the process or apparatus to bar him from modifying the statue as he pleases

The size of statue is regulated by varying the distance from center stand to camera projectors, after the record photographs have been obtained This is made evident by some of the accompanying illustrations. Within reasonable limits, all sizes of reproductions may be made from a single set of record photographs

The experiences of the model or subject are very pleasant in comparison to the tedious posing required by the old methods Only a few minutes are required for the taking of several complete sets of record photographs including the illuminating photographs which are sometimes used in the form of tinted slides for illuminating the finished statuary by projection

This process is adaptable to the production of practically all classes of statuary in all sizes and is especially useful in copying and enlarging sketch models or any other existing statuary One of the most valuable features is the case with which the record photographs of persons or objects may be taken and stored for safe-keeping until needed for the production of statuary at a later time.

The Story of Steel—II

(*Continued from page 109*)

the machine which makes a cut 40 feet deep and 175 feet in width Sixteen tons a minute means nigh upon a thousand tons an hour, and the tracks are so laid and the train so manipulated that the work of the shovels goes on, except for repairs, uninterruptedly night and day for eight months of the year

With these figures in mind we are prepared to learn that the Hull Rust mine alone, during the great activity of 1916, shipped out 7 665 611 tons of ore, or over 10 per cent of the total of 75,167,672 tons mined in the United States. The magnitude of the Missabe range mines, in comparison with the others in the Lake Superior district, is shown in the following record of output for the busy years of 1918, when the total output from Lake Superior was 62 836 172 tons. The shipments were: Vermilion, 1,192,908 tons Cuyuna, 2,478,800, Marquette, 4 354 297 Menominee, 6,378,698, Gogebic, 7,936,701, and Missabe 40,896,711 tons.

An estimate several years ago by the United States Government of our national wealth placed it at 220 billions of dollars, it may well be 250 billions today. If the writer were asked to name the principal agent in the enormous growth in wealth of this country during the past two decades, he would unhesitatingly name the vast iron deposits of the Lake Superior region and the consequent phenomenal growth of our steel industry.

Agriculture? But agriculture depends upon steel for the farming machinery that makes it possible.

Our vast railroad system? Dependent upon steel for locomotives, cars and the rails upon which they run.

Shipping? All now built of steel.

Our enormous factories? Steel framed and fitted with engines, lathes, tools, big and small—all fabricated from the steel and iron of the blast furnace and the foundry

Our cities, with their towering buildings housing many of them a whole townful of people Steel girders, columns and plates made them possible.

The future historian will surely designate our era as the Age of Steel.

The Heavens in February, 1924

(*Continued from page 110*)

Auriga high on the right. Perseus, Andromeda and Cassiopeia are in the northwest. Cepheus and Draco are in the north, below Ursa Minor, with Ursa Major in the northeast. Leo is well up in the east, and Arcturus and Spica have just risen. Hydra and Corvus, in the southeast, complete our list.

The Planets

Mercury is a morning star all through the month, and is best seen about the 5th, when he is 25° from the sun and rises at 5 45 A M Venus is an evening star and is becoming more and more conspicuous. In the middle of the month she remains in view until 8.30 P M. Mars is a morning star in Scorpio, rising a little before 3 A. M. Jupiter is close by, and on the 13th the two planets are in conjunction, less than half a degree apart. Saturn is past quadrature and rises at 11 P M. in the middle of the month Uranus is an evening star, but too near the sun to be seen Neptune is in opposition on the 8th, in 9h 26m 8s R. A. and plus 15° 20′ 6″ declination, at that time he moves 6 6s west and 32′ south per day This puts him on the western edge of Leo, in a region where it will be very hard to find him with out an equatorially mounted telescope

The moon is new at 9 P M on the 4th, in her first quarter at 3 P M on the 12th full at 11 A. M on the 20th, and in her last quarter at 8 A M on the 27th She is nearest us on the 20th, and farthest away on the 12th During the month she passes near Mercury on the 2nd Uranus on the 6th, Venus on the 7th Neptune on the 19th Saturn on the 24th, and Jupiter and Mars on the 28th

A total eclipse occurs at the February full moon, but as might be judged from the hour of that phase, it is invisible in the United States except in parts of Alaska. The whole eclipse is visible in Asia, and its close in Europe This eclipse is noteworthy for its long duration, totality lasting an hour and thirty-eight minutes. This is because the very center of the earth's shadow falls upon the moon—though not in the middle of the latter

The Blue Ribbon of the Atlantic

(*Continued from page 104*)

over 600 miles, and on one day ran 617 miles, which is the record for one day eastward or westward on this route. In making this day's run, she showed an average speed of 24 92 knots.

In 1913, the writer saw both the "Leviathan" and 'Majestic' under construction at Hamburg, and he was informed by their designer that they were identical ships in model, accommodation, and motive power, but that the "Bismarck" ("Majestic") was six feet longer than the "Vaterland" ("Leviathan ') This additional length was given the vessel he stated, so that the Hamburg-American Company might possess in the "Bismarck' the largest ship afloat. The greater length was secured by introducing two additional frames amidship. Since the displacement of the additional amidship body on a draft of 39 feet is 700 tons, the "Majestic" exceeds the "Leviathan" by that amount, her displacement being 64,800 tons as against a displacement of 64,100 tons for the "Leviathan" The "Leviathan" and the "Majestic" have the same turbine equipment, but the bigger ship carries two additional boilers, the "Leviathan" having 46 and the "Majestic" 48 water-tube boilers. The "Majestic" holds the record to the eastward with a passage of 5 days, 5 hours, 21 minutes, which was made at the record speed of the whole trip of 24.76 knots. Her best day's run of 609 miles was made to the westward. Her best all-day run to the eastward of 603 miles, was made at a speed of 25 66 knots.

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As the rich gray smoke curls from your lips, you'll wonder why you've ever denied yourself the luxury of these superfine Turkish cigarettes It's the only smoke for the Luxury Hour—that treasured hour after the day's work when a man's in the mood for Life's best

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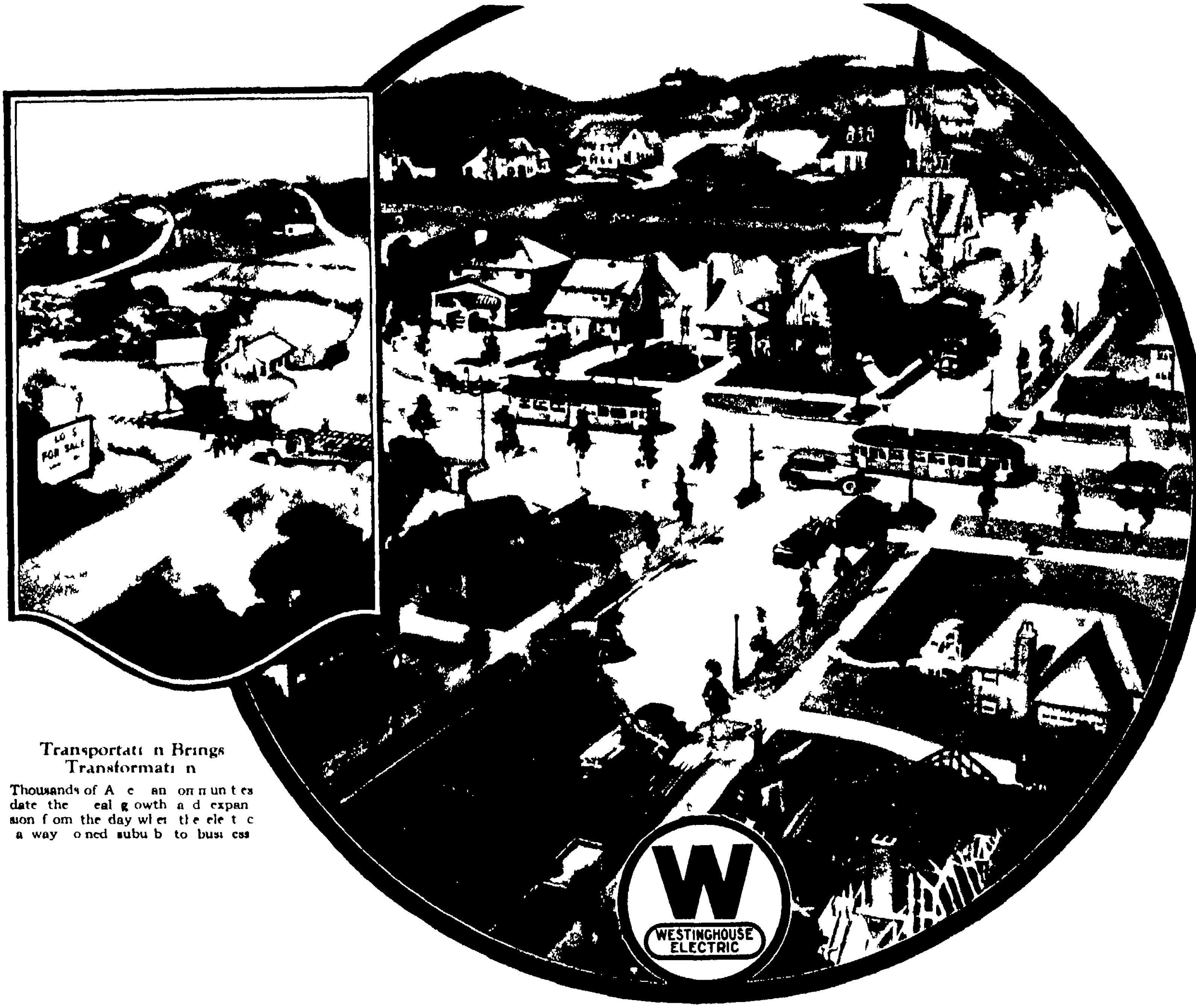

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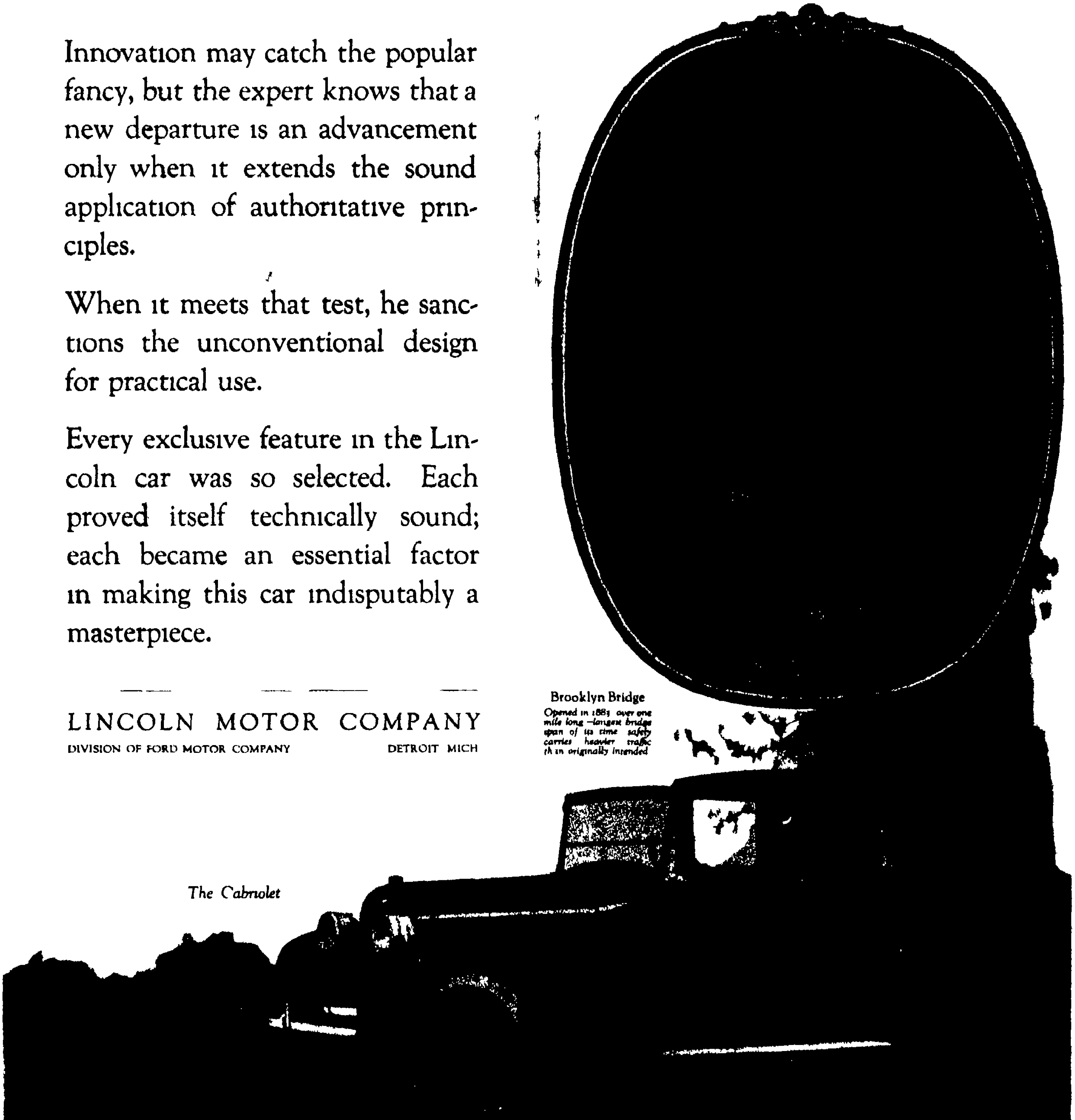

Brooklyn Bridge

Opened in 1883 over one mile long—longest bridge span of its time safely carries heavier traffic than originally intended

The Cabriolet

LINCOLN

THE SCIENTIFIC AMERICAN March 1924 Volume 130 Number 3 Published monthly by Scientific American Publishing Company at 233 Broadway New York N Y and printed in the U S A Subscription price, $4.00 per year. Entered as second-class matter June 18 1879 at the post office at New York N Y under the act of March 3 1879

With the Editors

OUR series of traffic articles has now reached the point where something in the direction of constructive suggestions is in order We are not without resources in this direction We have discussed the matter with various gentlemen who, as administrators of the law or as delvers into the statistics, may be assumed to have opinions worthy of attention But the main prerequisite for uniformity of law is cooperation If there are existing agencies through which such cooperation between the states is in the way of being obtained and if we go ahead without consultation with these agencies, we are quite as likely as not to run counter to their program Their ideas might be better than ours, ours might be better than theirs but whichever way this comparison might run, promulgation of our ideas in the face of theirs could only result in spilling the beans

AN admirable way turns up of avoiding this On January 24th and 25th the *Motor Vehicle Commissioners of ten Eastern States* met in conference in New York They do this fairly often—they have a permanent organization in fact, through which they keep track of one another's troubles and one another's ideas It was fairly obvious that at this conference material would be developed bearing upon our series, and equally that contact could be made by our editors with these various administrators So we have held the third article of our series over until April since we cannot wait until after the conference to write it and still get it in the March issue As we type these remarks, we have talked with three of the Commissioners seen their conference in session and are amply assured that our third article will be the better for the delay It will probably be given over to a discussion of the organization the aims and the procedure of the conference and *an indication of just what is to be accomplished* by this voluntary banding together of the State administrative officers

DR ALFRED ABRAMS is dead but *the electronic system marches on* In at least one respect the death of the founder clears the atmosphere No longer can it be claimed that only Abrams is competent to make a test on which judgment of his system shall be based No longer can our investigation be footballed back and forth from the practitioner to Abrams, from Abrams to the practitioner It will now be necessary for the electronic technique to stand on its own feet or ingloriously to fall Which, the next few months will doubtless determine.

IN THE meantime in far away Australia the Abrams treatment is breaking into the newspapers inflaming the public mind, and absorbing the attention of dominion cabinets Attention being focussed on the electronic diagnosis and treatment through a demonstration of some sort staged in New Zealand, the papers of Brisbane, Sydney and other continental cities demanded that their respective governments conduct an investigation Medical opinion was sought by the authorities, and was of course adverse, whereupon the authorities dropped the matter Not so the newspapers Screaming headlines about governmental inertia and suffering humanity alternated with facsimile reproductions of cablegrams from Abrams himself offering to extend help to an investigation 'in any way possible"—our readers will observe a familiar note Letters from people who have been cured of incurable cancers in a few days vie for position with other communications denouncing Abrams as a faker The SCIENTIFIC AMERICAN investigation is quoted in numerous ways One paper reproduces our opening article in which we *forecast a long and difficult investigation*, and throws this into the teeth of the Australian doctors who presume to denounce Abrams more or less offhand Governments are quoted as waiting upon the result of our investigation prepared to abide by this result and emphasizing the absurdity of duplicating our work Abrams and the SCIENTIFIC AMERICAN are furnishing the major political issue of the moment in the Antipodes

INCIDENTALLY our Abrams investigation as we go to press, is taking to the road All over the country there are numerous investigators some actuated purely by the desire to advance science, others we *fear moved mainly by solicitude* for their own finances but all working hard in the effort to isolate and identify and reduce to order the elusive and chaotic forces which if there be any truth at all in the *electronic system lie behind it* We shall call on a number of these gentlemen and let them exhibit to us just what they are doing It may be that they will be able to show us something startling., It may be that we shall be able to upset their pots of gold and fracture their rainbows as completely as we have already done in the cases of one or two local researchers But whatever the results of our contact with them there will be an interesting story to tell

AND while a section of the editorial staff is *en tour*, other things than the electronic reactions will come in for attention We shall for instance, visit the great engineering laboratories at Dayton and we shall come away from them with a story following out our recent editorial The automobile in the test tube For just as we had begun to flatter ourselves that the major problems of motor car design were about settled so that we might look forward to a period of comparative stability of type, these industrious scientists turn up some discoveries that give every hope of making present-day cars and present day fuels and present day practice look about as modern as the two lungers of 1904 that recently staged an endurance race in the streets of New York *Of course that doesn't mean that* we should get panicky about the last year's car that we have or the this year's car that we had thought of buying The factory is always five years or more behind the laboratory in an industry that produces on such a quantity basis as does this one and we may therefore be quite certain that whatever the epoch making innovations the next few months they will come into actual commercial practice in such a way as not to affect the stability of the industry

OUR traveling member will get as far west as Riverbank Ill where stand the magnificent laboratories described in a recent issue, the hobby of Colonel George Fabyan We have already told about the laboratories, as such Now we shall be able to put before our readers their specific work in sound human hearing, X ray therapeutics and *other interesting fields*

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EIGHTIETH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, MARCH, 1924

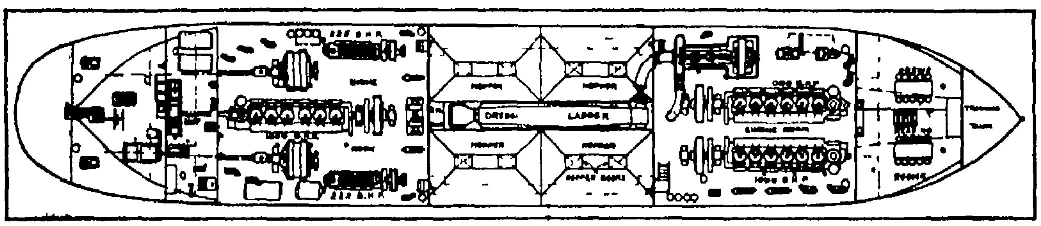
Keeping Open Our Harbor Channels

THAT most efficient body of men known as the Engineering Corps of the United States Army has designed four powerful dredges for maintaining the harbor entrances and channels of the United States, contracts for two of which have already been placed Particular interest is attached to these ships because they will be driven entirely by electric power, generated in a combination of Diesel engines directly connected to Westinghouse generators. Broadly speaking they are modeled upon the general lines of the existing steam dredges of the Engineering Corps, but in addition to the electric drive they embody many other improvements looking to high efficiency of operation

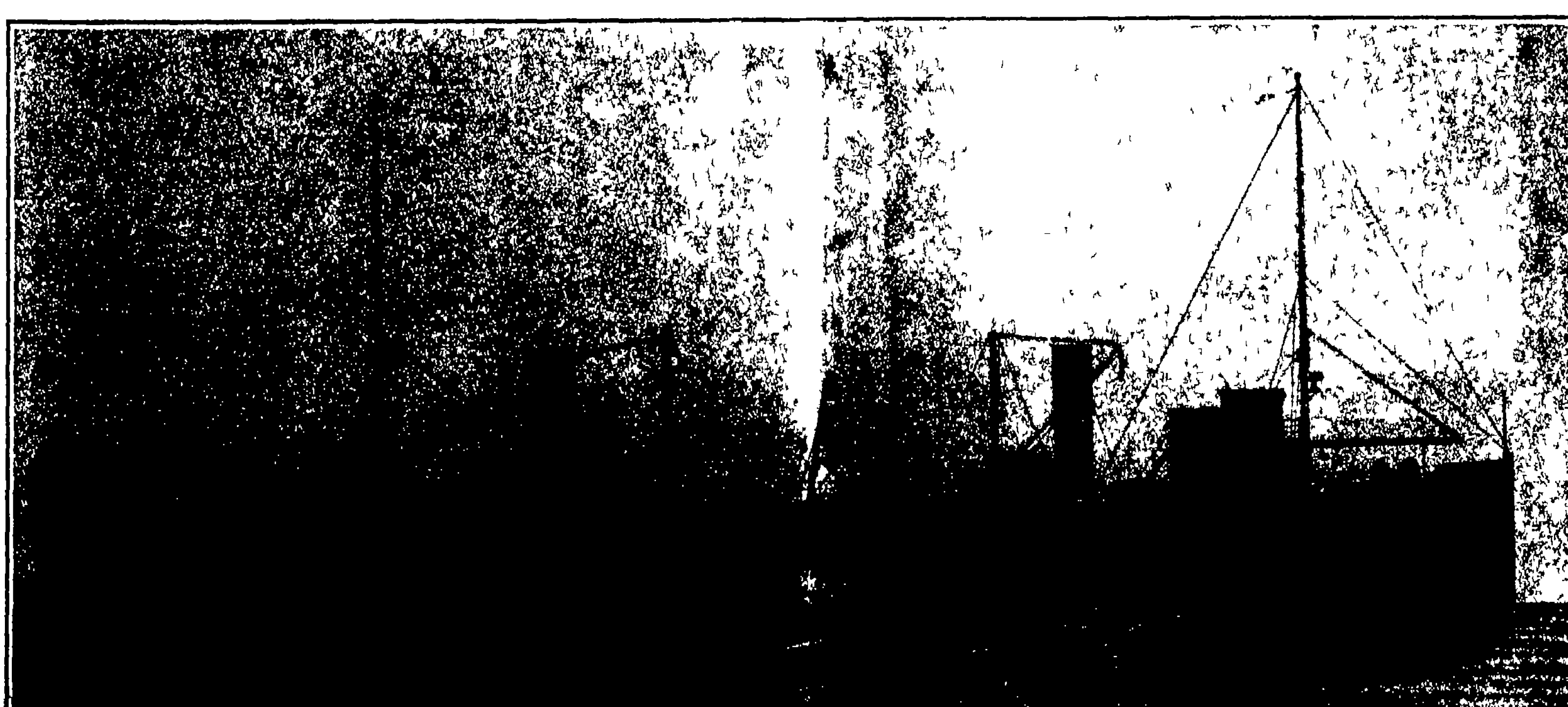
Each dredge is 268 feet 5 inches in length over all its beam is 46 feet and its depth 22 feet 6 inches Amidships are four large hoppers with a combined capacity of 1250 cubic yards The hoppers arranged two on each side of a central well, open to the sea, within which is located a 26-inch pipe 45 feet long, which is carried in a frame of steel lattice work The upper end of the frame is hinged to enable the pipe to be lowered to the river bottom for dredging operations At its upper end the pipe connects through a flexible joint to the suction end of an 800-horsepower centrifugal pump At the other or lower end is a heavy steel gridiron which is known technically as the drag In dredging the drag is lowered to the bottom of the channel the pump is started and the ship is run slowly along the course to be dredged out The drag, acting like a powerful claw, loosens up the sand or other material which is sucked up with the water by the pump and discharged into the hoppers When the bottom is hard powerful jets of water are discharged against the material, and the rush of water is sufficiently powerful to loosen anything short of rock

The power plant consists of three 1000-horsepower Diesel engines, each of which is directly connected to a 700-kilowatt Westinghouse generator There are also several auxiliary generating units These three engines are located in the engine rooms one of which is forward of the hoppers and the other aft of them The current for driving the ship is led to two 800 horsepower Westinghouse motors each of which is direct connected to its own propeller and these form the actual propelling machinery of the dredge The control of these motors is centered in a hand wheel in the pilot house so that the navigating officer can control the ship directly without the intervention of the engine-room staff Electric power is also used for the operation of the powerful suction pumps and for the raising and lowering of the dredging ladder The vertical movement of the ladder is controlled by cables which lead to the top of a steel A frame, mounted astride the well, and down to the lower end of the dredging ladder

It is doubtful if anywhere else either afloat or ashore are so many different applications of electricity to be found grouped together in so small and restricted a space In addition to driving the propellers the electricity opens and shuts the hopper doors, pumps the supply of water and fuel oil, compresses air for blowing the whistle makes ice and maintains cold storage, heats and ventilates the ship warms the fuel oil runs the machine shop tools handles the anchors operates winches and capstans heats the water, steers the ship, cooks the meals, and—lights the cigars, cigarettes and pipes if you please On each dredge are 56 electric lights, 100 electric heaters 25 electric fans and two electric ranges Mr W H Easton of the Westinghouse Company is probably correct in stating that these dredges are the first habitation of civilized man where fire in some form or other is not needed We understand that the United States Engineering Corps will make careful tests of the equipment of these dredges under all conditions of operation and will publish the results The work done by the army in establishing and maintaining the harbors of the United States includes deepening Boston from 20 to 40 feet New York from 19 to 40 feet, Norfolk from 12 10 to 35 40 feet New Orleans from 9 to 30-35 feet and many other harbors from 8 or 9 to 30-35 feet



Plan showing arrangement of engine rooms, hoppers and dredging mechanism



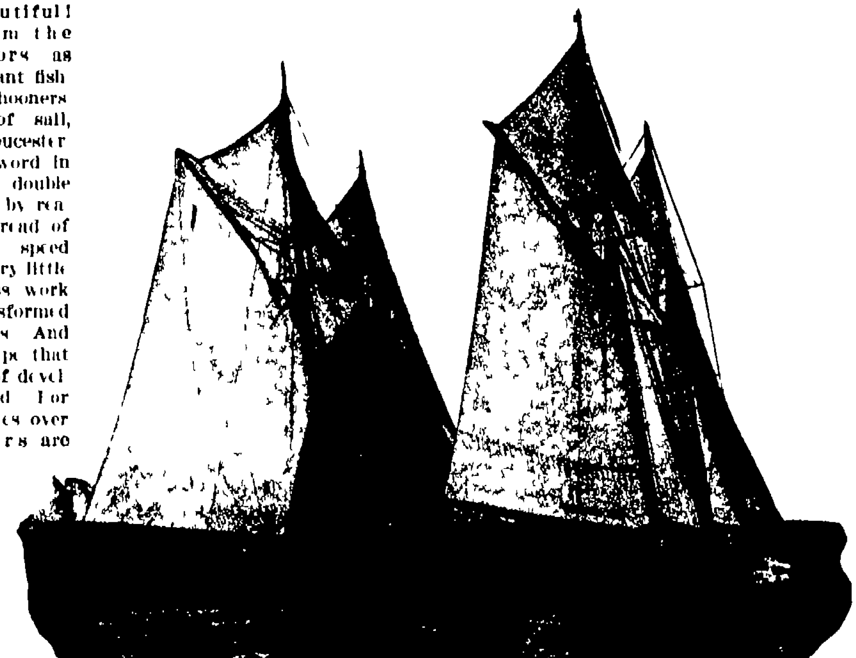
New, Diesel-electric dredge for army engineers. Length, 268 feet 5 inches; beam, 46 feet; depth, 22 feet 6 inches, hopper capacity, 1250 cubic yards. Two of these are being built. They will keep open the channels of our harbors and rivers

Necessity Mothers the Fisherman

Taking the Smell and the Sails Out of His Daily Routine

By James H Collins

HOW beautiful! exclaim the spectators as two gallant fishing schooners clouds of sail, vie for victory off Gloucester. They are the last word in fishing vessels in a double sense. The last word by reason of their great spread of canvas weatherliness speed and beauty—with a very little white paint and brass work they would be transformed into gentlemen's yachts. And the last word as a type that has reached its limit of development and is doomed. For no sooner are the races over than both schooners are hauled into dry dock and their engines restored. The beauty that thrilled spectators is the beauty of a dying type making its last gallant stand against a new and spectacular order of things.



Start of the first official race of fishing schooners off Gloucester—the type of fishing vessel now being transformed into motor ships

Our Atlantic coast fisheries have reached a stage where necessity the mother of invention, has been called in to save and rehabilitate them. This was virtually the first American industry. It has furnished fighting men for our navies seamen for our whalers and clipper merchantmen, pathfinders and discoverers in the world's unexplored regions. For nearly three hundred years it has been conducted with little change in principle though steady progress in the size of boats the length of voyages the improvement of fishing gear and methods. But fishing has become less and less profitable with the development of industries ashore. The hardy New Englanders who sailed out of Gloucester and other shipping ports until fifty years ago found better opportunities in the factories that sprang up in New England and were also fitted for better paying work by education in the public schools. They were replaced by the equally hardy 'Blue Nose' of Nova Scotia. With the forest on one side and the sea on the other, he was forced to lumbering or fishing for a living the agricultural resources of his country being meager. But now industry and schools make new opportunities for the Nova Scotian and he no longer finds fishing profitable—unless it can be put on an entirely new basis.

Fish are abundant and the cost of catching them only a few cents per pound. But even a short distance inland the consumer pays five to ten times as much. Thus what should be a staple food is regarded as a luxury. Where the British eat 65 pounds of fish per capita yearly Americans eat less than 15 pounds.

Worse by methods of distribution thus far used fish do not always reach the consumer in prime condition. From the fishing schooner straight through to the peddler with a push cart and tin horn who hawks fish about the streets the fisherman has fallen behind other food industries in production and distributing methods and suffers competition in two ways. First the competition of more efficiently distributed foods. Second, the competition of other industries that divert man power.

But now the inventor and research expert are coming to the fisherman's aid. The hard rough, hazardous work aboard fishing vessels, that keeps men away from home is being lightened and fishing trips shortened, by the use of power instead of sail. The motor vessel lands fish more quickly after catching. Instead of being shipped whole, paying freight on waste and ice, the fish are dressed at seaboard cut into filets or slides, wrapped in vegetable parchment paper, chilled and shipped in various types of insulated containers. Fish are not only brought into the great trend toward sanitary package foods, but into the great distributing organizations that market other foods. Heretofore limited to a few fish dealers and peddlers in the community now fish can be sold by the grocer and butcher. The offal which was formerly expensive waste can now be turned into oil and fish meal at the seaboard for soap making, cattle and poultry food fertilizers and in fact a wide miscellany of other applications.

Ten or fifteen years ago the fisherman began installing gasoline engines. The industry is conservative however, and the rising price of gasoline was an adverse factor. Since then, oil engines of Diesel type in sizes as small as five horsepower have been developed and it is predicted that sail will be a thing of the past in two years. Of 13,000 tons of craft fishing out of Gloucester 5000 are oil power, 4500 gasoline, 2000 sail and less than 2000 steam.

With sail the fisherman spent several days reaching the fishing grounds, and when his catch was complete set out for port often against head winds. The length of time needed for the return trip was uncertain. It might take a week and each day's delay had its effect upon the freshness of his catch. With sail, too, he could not leave port without the large crew needed to work the vessel. With motor power, it is possible to run virtually on schedule making a round trip in three days a day to go, a day to fish, and a day returning. His catch is fresher, he can make a greater number of trips in the season, and the vessel is easily worked by a small crew when men are scarce.

Thus the spic and span yacht like schooner, the fisherman's pride is being transformed. The sails are furled down to stay until they rot except for light riding canvas. When they are gone the booms are taken down leaving only the masts. The fisherman turns from sailor to mechanic spends less time afloat and more with his family, and with the wider market and better prices in sight will find his occupation more nearly on the level of shore industries that have been drawing him away.

Among other inventors, Uncle Sam has made an important betterment through his chemists in the Bureau of Fisheries Department of Commerce. This is a chemical preservative for fishing gear. Nets seines and traps are both fragile and costly—a very simple looking piece of gear may represent an investment of many thousand dollars. It is subject to salt water, sun, air—most of all, marine growths. From the earliest times fishermen have sought some preservative that would lengthen the life of gear. Tan bark has been used and tar. These lengthen the life of gear, but make it heavy stiff and difficult to handle. Chemists have found what seems to be an ideal preservative in copper oleate which is now available in a soapy preparation that with gasoline, makes a solution into which gear is dipped. It adds hardly anything to weight, and does not affect flexibility. While figures are not yet available, it is estimated that copper oleate will lengthen gear life at least 50 per cent and in some cases double it.

Fish filets wrapped in sanitary parchment-paper, with shipping case. Package fish of this sort is revolutionizing the industry

The quality of fish will be greatly improved when inventors perfect artificial refrigeration units small enough to be installed on fishing vessels. Artificial refrigeration is already an important new factor in the handling of fish ashore, but practical apparatus for vessels is still in the future, and ice is used instead.

On the average only half the fish is food from 30 to 70 per cent being offal, according to variety. Seventy per cent of flounder goes into the garbage can when the consumer buys the fish whole, 60 per cent of whiting, 55 per cent of cod and haddock 50 per cent of mackerel. Yet this waste can be turned into by-products that come pretty near paying the fisherman's price for the fish. Until recently, it was not economical to fishermen to turn offal into by products. The apparatus needed for making fish oil and

fish meal was obtainable only in large units and required a considerable investment and a large volume of offal to work on Now the inventor has come to the fisherman's aid, and units capable of handling waste of a moderate-size fish dealer's business can be secured for less than ten thousand dollars They are virtually automatic in their operation, cooking the offal, extracting the oil, drying and grinding the meal with only one or two workers

One of the really magical inventions for the fisherman is a sheet of paper Under the new way of butchering the fish at the seaboard, utilizing the by-products different varieties are cut into filets, steaks and boneless sides, and some small varieties like panfish scaled and cleaned ready for cooking These cuts are wrapped in vegetable parchment paper, put away in a cold room to chill, and then shipped in insulated containers of various types that keep them cool several days The parchment paper is water proof and odor proof Fresh well-cleaned fish have little or no odor, but if these filets and steaks did have a "fishy" smell they could be put in the grocer's refrigerator with butter or any other delicate food article Moreover, the housewife can boil a cod or halibut steak in the paper wrapper which would retain the odor of cooking, and the wrapper prevents loss of moisture or flavor as well

The fish filet has brought a revolution in marketing It began experimentally in Boston about two years ago when haddock filets were wrapped in parchment paper and shipped without ice to New England towns during the cold weather Summer brought the shipment to an end and they were never made far in land. But one fish dealer's faith in the idea was so strong that he developed a compact box in which a tin container holding the wrapped filet could be shipped with a moderate quantity of ice A very large part of the difference between sea board and consumer prices of fish is freight, not on food but on ice and offal Success was immediate Inland grocers and butchers found that people who know ocean fish only by reputation, became customers for these fish filets Inventive ability has been centered upon shipping packages of various types packed to carry fish filets with the minimum amount of ice, and others requiring no ice at all One notably successful package of the latter type, patented by its inventor is made of corrugated fiber, and has carried shipments of chilled filets clear across the continent in summer Besides making fish a package food for the grocer and butcher, shipments are sent regularly to hotels clubs and institutions It is estimated that people even within easy shipping distance of the Atlantic seaboard now eat one-quarter as much seafood as they would if it were obtainable regularly at reasonable prices—which gives some idea of the market the filet fish trade has set out to develop

This package idea is being successfully applied to fish in another way, making it even more staple as a food product for the grocery store and butcher shop That is, the packing of cooked fish in glass jars, a wonderfully tempting product for the eye when a silvery patterned fish like the mackerel is packed in clear liquor Glass containers display fish in the show window, so to speak

Uncle Sam has put his shoulder to the wheel at the marketing end, through the Bureau of Fisheries making surveys of representative cities, securing the names of wholesale and retail dealers with the kinds of fish each handles, the sources of supply transportation facilities and rates, the preference by nationalities for particular kinds of fish, and like data. Some of the facts brought to light are startling Louisville eats only six pounds of fish per capita yearly Chicago has only 222 exclusive fish dealers, compared with thousands of butchers and grocers, and eats chiefly fresh water fish, more than two-thirds of which come from Canada Boston has unlimited fish at its front door, yet its fish trade is largely local, Massachusetts alone consuming 58 per cent of Boston's total catch and only 11 per cent going beyond New York and Pennsylvania Many inland cities and towns have a prejudice against and even fear of salt water fish, based on indifferent quality under the old methods of shipping whole fish in ice One promising market suggestion made by the Bureau of Fisheries is that fish be shipped in carload lots on a regular schedule dropping off consignments at different towns en route

A single minor invention shows the inventive "uplift" now going on in the fishermen's business that of rendering fishing vessels and fish markets odorless Fresh fish do not smell but the slime they leave behind in bilge water and on floors and receptacles does—in bilge water it smells villainously It has been found that these odors can be eliminated by putting electrolytic hypochloride of soda in the bilge water and using it as a spray or cleansing solution around markets, piers and any other places where fish are handled

The fisherman is going to college At the University of Washington, the College of Fisheries has been in operation since 1919, under Dean John N Cobb, concentrating in Pacific Coast fishing, while in the East research work on fisheries is being carried out at the Massachusetts Institute of Technology Thus far, the vast amount of scientific work on ocean life has been done by deep sea expeditions, and along zoological lines —very little has been done along the coasts where the fisheries are and even less from an industrial and commercial viewpoint

Besides the inventor the fisherman needs the help of the capitalist the salesman and the advertising man Commercially, the fish trade has been one of small dealers inadequately organized and financed for distribution using outworn business methods Today new money is coming into the butchering and distribution of fish new companies are being formed or old ones consolidated and there is noticeable improvement in business methods The salesman given fish in sanitary packages can extend its distribution to grocers and butchers The advertising man through the printed word can dispel popular prejudice against fish and break down serious handicaps like the consumer habit that leads people to think of it only on Friday

But the fisherman needs the inventor most of all From his vessel and his gear straight through to packages and by products there are opportunities for the inventive mind—provided it will tackle the fisherman's peculiar problems after first hand study

Some idea of the field for research invention and promotion is given by Dean Cobb in a summary of possibilities in the fish itself

A hundred thousand tons of fish offal such has been thrown away for years if transformed into oil and scrap is worth more than five million dollars

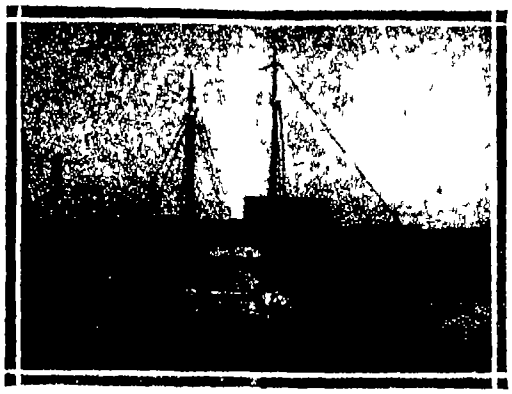
But when fish are butchered like meat animals there will be even more valuable by products To turn all but the edible portions of a fish into oil and scrap indiscriminately is sinful

As in the packing industry there are choice tid bits about fish now going to waste because only a few people living along the seaboard know what dainties they are and how to cook them To most inland people, the idea of eating fish heads sounds fantastic though they relish calf's head a la vinaigrette The meat found on fishes heads is the choicest of any part of the body and the cheeks or meaty portions found on the sides of the heads of salmon and halibut the choicest of all Cod tongues are another delicacy that now go largely to waste for lack of popular appreciation and cod sounds still another The sound is the air bladder of a fish in the cod relatively large "tongues and sounds" is a constant item in the menu of New England hotels and restaurants.

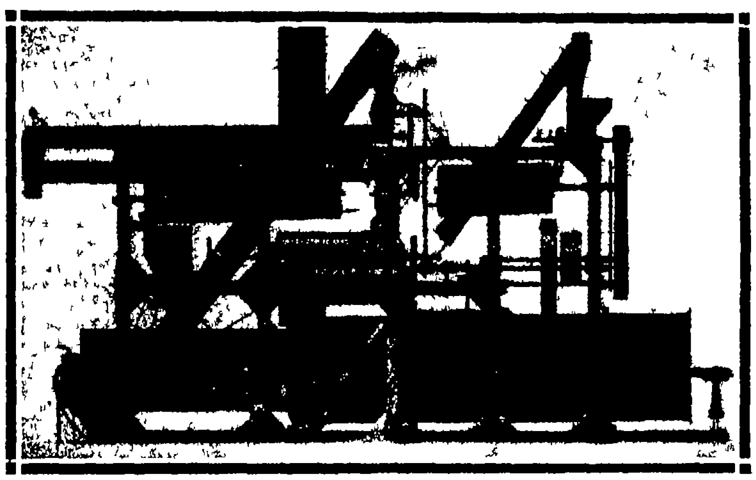
Fish eggs are another large item of waste in the industry going into fish meal if they escape the garbage when they are really a delicacy in themselves if properly cooked or in some cases can be made into caviar or canned for use as fish bait

Likewise, fish yield industrial by products equivalent to the pepsin and other pharmaceuticals of the meat packing industry Sounds are used industrially particularly for the clarifying of various liquids Another interesting example is the use of fish scales to make an artificial nacre used in making near pearls Fish oil is not only a substitute for higher priced oils in certain industries, but when care is taken to make it of sound quality can be used for edible products after being put through the hydrogenation process Fish glue and fish leather too, are capable of development

The fisherman's vocation has fallen behind in the general progress of the food industries It now calls for rehabilitation through invention research and better business methods This rehabilitation it is getting



A Boston fishing schooner, with motor installed and sails furled to stay down till they rot



Typical apparatus for reducing fish offal to oil and meal, doing the work automatically though on a small scale

The chain-store idea applied to the retailing of fish makes an appeal to the consumer quite different from that of the old fashioned fish peddler

Arctic Exploration by Aircraft

"Shenandoah" to Reveal the Secrets of the Uncharted Polar Seas

By a Member of the Board on Arctic Exploration

THE purpose of naval exploration in the Arctic is to determine and chart the location of land in an area one-third the size of the United States. This 1,000,000 square miles lying between Alaska and the North Pole is as yet unexplored. A single dash into such an area determines little. To know the area requires search and mapping by aerial photography in a systematic way. The work of the first summer could accomplish reconnaissance, the possible general location of some land, the proof of the feasibility of charting by the dirigible "Shenandoah" and by planes equipped for work on ice and water and the establishment of bases with dirigible mooring masts from which the whole work could be continued in the future. If any land is located or if the charting proves that land does not exist then the United States has added that much to the scientific knowledge of the world.

Imaginative people who are not interested in this dull charting of islands say the United States may through this work, be the first to establish an air route from Western Europe to Japan over the top of the world. An island here and there as a possible landing place is of more interest to those of a practical turn of mind. This short cut from London to Tokio would be made by flying from Spitzbergen to Nome, Alaska, via the Pole. The distance between the last two places is about 2200 nautical miles. The cruising radius of the "Shenandoah" at fifty knots is 3000 nautical miles with an additional margin of 15 per cent. The real business of exploring and charting the region north of Alaska has confronted aviation with problems that are forcing design forward with great strides. Short of actual war there has been nothing that has acted as more of a prod to designers and operators than the order of the Secretary of the Navy to do this work by aircraft.

Both planes and the dirigible "Shenandoah" are necessary for this work. The "Shenandoah" is used chiefly because of her greater cruising radius but she has added advantages in ability to carry considerable photographic equipment, scientific instruments, and ability to hover over a spot to take observations of the sun for fixing locations of places on the earth's surface. The planes are of use for shorter flights in the neighborhood of the northern operating base. These planes can secure aerological data that can be sent by radio to the United States to acquaint the dirigible as to weather conditions. After the northern base has been established with a mooring mast for the dirigible the "Shenandoah" could fly by stages from Lakehurst, N. J. to the Alaskan base.

In the selection of a northern base the vicinity of Nome, Alaska, offers the best site to an American expedition. This is because of its early accessibility by steamship the ice breaking up off Nome in the first week of June. It is near the unexplored area and at the same time within easy reach by radio of United States bases. It has some local facilities for landing the materials of masts and other equipment, and it is in United States territory. Points in Greenland and Spitzbergen are much nearer the Pole than Nome but since one summer month will be spent in establishing a base only two months of summer are left—July and August. Two ships are being equipped with mooring masts, one to be stationed at Nome the other at Spitzbergen. At Nome the mean temperature over a number of years has been June 45 degrees Fahrenheit, July 51 degrees Fahrenheit, August 50 degrees Fahrenheit. All things considered the vicinity of Nome is the best location. Nome is 1500 nautical miles from the Pole.

The exploration of the whole area this distance would dictate a more northern base. Pt. Barrow the most northern point of Alaska is 1100 nautical miles from the Pole but the ice conditions prevent its being reached until the first of August, and then only by small vessels especially constructed for withstanding the force of ice jam and working through the broken ice. At Pt. Barrow there is no certainty of landing the structure materials and fuel for a complete base in a single season. This is because there is clear water off Pt. Barrow only for two to three weeks and in some seasons it has been known to last only for six hours. At Pt. Barrow the mean temperatures over a number of years have been June 35 degrees Fahrenheit, July 41 degrees Fahrenheit, August 39 degrees Fahrenheit. It might be advisable to cache gasoline here for refuelling. Two hundred people could hold the "Shenandoah" in a calm while this was done. If a mooring mast could be erected here in one season it would be of great use in succeeding seasons for securing the "Shenandoah" for refuelling. The problem of transporting 60 tons of mooring mast and of taking gasoline and workmen to Pt. Barrow is involved in this.

As the "Shenandoah" in crossing high mountains gets into rarer atmosphere the helium in the large gas cells of the bag expands and would rupture the cells if helium were not let out or "valved." This means a loss of helium, which is very valuable. This loss can be prevented in ordinary operation where the heights encountered are considerably less than those of the northern Rockies. If previous to the flight the greatest elevation to be met is known, then the "Shenandoah" starts with cells partially filled with helium so that they will expand to about 100 per cent capacity on reaching the highest point, but will not expand to a point where valving is necessary. However, to cross the 8000-foot Rockies enroute to Seattle, the "Shenandoah" would have to start with gas cells 23 per cent short of full. But this presents another interesting problem in the performance of the dirigible, namely that with only 77 per cent of gas in the bag there is not sufficient lift remaining to buoy up all the gasoline that is required for fuel on the trip from Lakehurst to Seattle. All of this can be obviated by crossing the Rockies in the South where they are lower, i. e. by flying from Lakehurst to Fort Worth, Texas, 1191 nautical miles, from Fort Worth to San Diego, 1003 nautical miles, from San Diego to Puget Sound via the coast 1150 nautical miles.

The use of gasoline fuel during the long flights necessary for exploring lightens the ship considerably. This means that she is too buoyant and would rise to altitudes not desirable and that to come down helium would have to be "valved," to make her less buoyant. This did not worry the Germans on the short flights from Germany to England but both the Germans and English have given considerable thought to this problem of becoming lighter as fuel is consumed. On the long flights to be made on this expedition this is serious and is being cared for in a most interesting way. A means has been found for recovering enough water from the gasoline burned to make up for the loss of weight in gasoline. This water recovery is possible because when gasoline burns, one of the products of combustion is hydrogen which, when combined with the oxygen of the air gives water sufficient to replace the weight of gasoline lost as fuel. With ability to manufacture water ballast on board the valving of the precious helium in descending is avoided.

Although the winds for July and August average seven miles per hour at the Nome base the "Shenandoah" must be prepared for occasional gales that blow here as high as 60 miles per hour during these months. To be able to meet adverse winds with a good margin of fuel is the chief reason for reducing the length of flights considerably below her full cruising radius in calm weather. When free in the air she can safely ride out a gale but must have sufficient excess of gasoline to permit her to do this and then tie up at the end of the storm and refuel.

A mooring mast for the "Shenandoah" built on a ship would serve to advance the base at Nome by the amount the ship is able to proceed to the northward from Nome as the ice clears. A ship large enough for this is not small enough to work through the ice as the wooden sealers and whalers do, but must wait for comparatively clear water. This ship with a mooring mast, in addition to reducing the length of trips of the "Shenandoah" by two or three hundred miles, also may prove valuable in being able to seek a lee where the wind is much less than at the permanent Nome mast.

Another ship fitted with a mooring mast and stationed at Spitzbergen would act as a still further aid in shortening the radius required of the "Shenandoah," for suppose that on exploration work in the neighborhood of the North Pole, adverse winds are encountered on the return to Nome (1560 nautical miles from the Pole), then the "Shenandoah" could continue on to Spitzbergen which is only 640 nautical miles from the Pole. Spitzbergen was selected as a base for dirigibles by Count Zeppelin as early as 1910. He went there with Prince Henry of Prussia and a staff of scientists and selected a low open valley as an admirable site for an airship base for North Polar work. The Germans kept a party on aerological work there until 1914.

For all this long distance work the "Shenandoah" must have good communication by radio. The demand has already been put upon radio engineers to double the radio transmitting distance from the "Shenandoah," thus improving the ship's usefulness both as a naval scout over long sea reaches and improving one of her commercial needs. In addition she will be equipped with radio compass for taking bearings on radio transmitting stations in America and Europe and thus assist the navigators in locating her position in the polar region.

POLAR exploration via the air, barring the premature enterprise of the unfortunate Andree, is a totally uncharted field, and those who enter it must make their own rules. What these rules are to be in the present aerial attacks upon the pole is indicated, so far as is possible in advance, in the long and the short articles on this page. Attention is also called to the discussion on page 154, in which a member of the Naval War College gives us some indication of what the explorers hope to find. —THE EDITOR

Amundsen's Flight to the Pole

THE activities of the Navy Department in Polar exploration will not be confined next summer to its own work by means of the "Shenandoah." According to an announcement made last year by Secretary Denby, Lieutenant Davison of the Navy will command one of the three seaplanes with which the Amundsen expedition will make the attempt to reach the Pole and ultimately cross over to Alaska itself.

A non-stop flight across the Arctic regions is not in contemplation. The distance from Spitzbergen to Alaska is about 1750 miles, and it is intended to make the flight in relays. The first step will take place early next summer, when the planes will be carried by ship to the edge of the ice pack, which, it is expected, will be found at a distance of about 450 miles from the North Pole. From this point flights will be made to the Pole, where there will be established a depot of supplies of food and fuel. For this bold undertaking Amundsen has chosen the Dornier Dolphin flying boat which has been so built that it can take off with equal facility from ice, snow, or water, and of course, make corresponding landings. Each seaplane will carry radio of sufficient range to enable it to keep in communication with the depot ship.

The Dornier machines are monoplanes of the all-metal type. At the bottom of the plane is a member which is designed for taking off or landing under difficult conditions. It is actually a small wing, so shaped as to afford a certain amount of lift. Its under surface is strongly ribbed to enable it to ride without damage over the rough surface of the ice. The body of the plane is commodious and it provides warm, enclosed cabins which are as completely appointed and as comfortable as the cabin of a small yacht.

The squadron of three planes will be manned by six men, one of the planes being under the immediate command of Captain Amundsen. Judged from the naval standpoint, the navigation on such a flight as this will be of particular interest, for in the Arctic region lying adjacent to the Pole, the magnetic compass will be practically useless and all courses will have to be laid by the sun. The 24 hours of daylight will be favorable to this, but on the other hand there will be a disadvantage to radio communication.

Of great help to the explorers will be the double sextant which is used in the United States Navy for the navigation of airplanes. This instrument eliminates the necessity for a horizon in making observations of the heavenly bodies. Probably it will be used in place of the artificial or mercurial horizon.

The "Shenandoah" over the ice fields

Double sextant for Arctic navigation

Three of these roomy planes will be used by Amundsen

MAP SHOWING THE UNKNOWN REGIONS OF THE POLE WHICH THE NAVY WILL EXPLORE WITH THE "SHENANDOAH" NEXT SUMMER

Gun Catastrophes

Some of the Reasons Why Small Arms Open Up at Points Where They Were Not Intended to Open

By Capt Edward C Crossman

No factory load is likely to mistreat a revolver thusly, a break of this sort is the result of a powder overload, and is usually from reloaded ammunition

ACCORDING to figures compiled by the Government there are some seven million hunters in these United States and each year some small proportion of the said seven million turn up at the gun sellers mart with a tale of woe which would move even a police court judge to tears The tale invariably is one in which the gun used by the huntsman proceeded to shed its component parts or develop unusual openings in the barrel in a fashion totally reprehensible not to say low down, and entirely uncontemplated by the manufacturer thereof

Few people with any considerable experience in the use of firearms have missed that pleasing and interesting sight of a gun suddenly erupting in a spot where no eruption was planned in its original design The performance is not surprising in view of the many grades of guns for sale, the many sorts of people using them, the high internal pressures of even the small and inoffensive .22 caliber and the unfortunately hasty and irascible disposition of a charge in the barrel when some obstacle is placed in its way

Without exception in the tale told by the shooter, the fault lies in the gun or the ammunition or both Cold analysis of cause and effect and reproduction of the wreck by the means suspected develops that the tale usually lacks sadly in accuracy in fact is about 90 per cent shy thereof Because while it is human to err and gun and ammunition plants are run by human beings, however the shooter may doubt the fact at times, the factories are systematized and possessed of vast experience neither of which can be said of the merry hunters who sally afield each season

About 90 per cent of the blown up guns may be laid at the door of the shooter—due to his sins of commission or omission If he was using reloaded or home loaded ammunition at the time of the unfortunate incident a prima facie case is established against him It may not be a conclusive one and he may prove an alibi but most of the time ammunition grown in the old home garden and used in a gun which ceases to be useful as a gun is at the bottom of the trouble

Shotguns and pistols pretty well divide the field of firearms catastrophes between them the rifle bringing up a bad third in the hard luck race This is true largely because the shotgun has comparatively thin tubes and because it is so often used under conditions which encourage getting the bore plugged with mud or snow Likewise is the unfortunate fact that two sorts of propellants are used in shotgun ammunition one a powder practically fool proof because of the space it occupies, and known as 'bulk' the other using up very little room for equivalent charges and hence, if loaded by an ignorant loader in a "bulk" measure or through the semi-occasional mistake of a factory resulting in a generosity of charge which proceeds to take the gun barrel apart

Revolvers and pistols are unfortunate in that their ammunition is very touchy in loading and in later storage The quantity of powder used is so small—from two grains weight upward—that a fine chance offers itself for more than one load in a cartridge or no load at all in the very rapid automatic loading machines The very light, feathery grains of much of this dense pistol powder are prone to stick in the measure because their weight is not enough to overcome the friction or cohesion of their little paper-thin grains

Also queerly enough the bullet which after leaving the muzzle is powerful enough to drill through a man, has so little spare energy that it sticks in the bore of the pistol with little provocation This is particularly likely to occur with metal jacketed bullets with their very high friction against the bore walls I have often seen bullets from the well known and standard 32 automatic pistol cartridge when fired in an adapter in a 30 caliber rifle barrel of practically the same bore size take two seconds for the trip of the bore, and strike the ground a few feet from the rifle, proving that the friction of the bullet nearly offset the thrust of the powder gases This is marked when the rifle has been fired previously with the service charge and left uncleaned with the sticky residue in the bore

With the automatic pistol the charge insufficient to drive the bullet out of the bore is also insufficient to function the mechanism and the attention of the shooter is usually invited to the irregularity by the fact that the gun did not reload itself With the revolver no such warning is given unless the shooter senses the reduced recoil and a second chamber fired without noticing anything wrong with the first will infallibly produce a ruined gun through the presence of the first bullet sticking in the bore

A government Springfield rifle that blew up in the hands of a navy rifle shooter The ammunition was tested, cause of accident unknown

Pistol cartridges habitually left in the gun are sensitive to the presence of oil or cleaning fluid which is also often found in the chamber or cylinder of the revolver Some oils and some cleaning fluids are so subtile that they will leak in past the primer or past the bullet and spoil the powder or primer Smokeless powder is very sensitive to oil or grease

The result of such leakage, common enough to impel one large factory to produce a special line of oil proof revolver and pistol cartridges, is either a misfire or a weak combustion of the powder sufficient perhaps to move the bullet up into the barrel of the gun, but not out of it

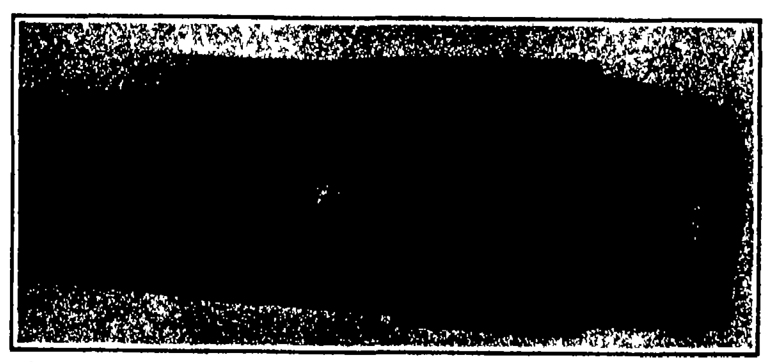
Pistol ammunition left in storage in a high temperature such as might easily be developed close to a steam radiator or a chimney is sufficiently reduced in power to cause bullets to stick in the bore of a pistol While visiting a Government arsenal during my duty as an army officer tests were made in my presence with ammunition for the service caliber 45 automatic pistol which was exposed to a temperature of 150 degrees Fahrenheit for 12 hours and then fired through the chronograph Five makes of ammunition were tested One gave normal results one showed a loss of 50 feet in range out of the original 800 feet, two others showed a loss of 150 feet and of the fifth, four shots stuck in the bore of the pistol, while the other six, though leaving the muzzle, failed to reach the other end of the short chronograph range Of the ten shots made with one of the brands that dropped 150 feet off their range under these conditions, two also stuck in the bore With the automatic as pointed out, this would not function the mechanism of the gun as a rule, but if the slide were hauled back by an excited man and the gun fired with a normal charge, it would infallibly burst the barrel or bulge it enough to lock the gun against functioning

These troubles however, almost invariably result in wrecked barrels and possibly the slide encircling them in the case of automatic pistol When the factory or gun merchant is presented with the spectacle of a revolver with three chambers blown into one and giving the general appearance of a house with the front wall removed and two or three floors left exposed to the public gaze then he can usually inquire into the sort of charges the owner used in his reloading, for this sort of wreck is not often seen except when hand made ammunition is used and the happy ammunition expert gets two or three charges of powder into one case as is easily done through the superabundance of room therein

Most shotgun troubles arise from obstructions in the bore and the cause is easily diagnosed from the location of the burst Overloads of powder invariably blow out a section of the chamber lying over the case or immediately forward of it at the "cone" or reduction of chamber diameter to barrel diameter The gentleman attempting to blame the ammunition for a handsome rent in his gun barrel a foot from the chamber is trying to make a 10 per cent grade with only 10 pounds of steam Faulty ammunition does not so perform Most shotgun shooters know this and their plaint with a burst barrel is that the material was defective or there was not enough of it for safety

While it is true that faulty stock gets into a barrel now and then, through a seam or burned spot in the original forging, and while a double-gun factory has been known to strike a barrel down to a paper thinness, still the odds are ten to one that this is not the cause when a barrel develops a large and deckle-edge rent where the gun had no rent before

The belief used to be common that sealing the bore of a firearm would then and there, on discharge, result in the exit of the charge from an extemporaneous opening in the barrel created just short of the seal



Chamber of a service-rifle barrel, fired with mud in the muzzle. The barrel sectioned itself very neatly

Experiments, both of my own and of gun factories and arsenals, fail to agree in results with this theory with all due respect for its advanced age and its grey hairs. Grey hairs, of course occur at times even on a donkey. Likewise does the ancient theory, once vigorously upheld, that a burst in a gun barrel from an obstruction is caused by the compression of the air fail to check up with the results of experiments.

Experiment proves that to burst or bulge a gun barrel an obstruction heavy enough or sticky enough to cause a perceptible check to the charge must be used. Sealing of the bore, that is preventing the free escape of the air pushed ahead of the charge is not at all essential in the wrecking of a gun barrel. The bore may be sealed freely provided the means used for said sealing, such as thin paper tied over the muzzle is not sufficient obstacle to check the charge.

When the obstruction is sufficient to check the progress of the bullet or load of shot a certain wave action is set up in the powder gases following behind, giving enormous increase in the pressures, and sometimes but not always, bursting or bulging the walls of the barrel.

An old superstition held that the suction of the gun bore of the shotgun was sufficient to draw the basewad from the case and suck it up the bore a certain distance until friction overcame the decreasing drag of the suction. Then upon the next shot the basewad would trip up the charge and burst the gun barrel. So firmly is this believed that one ammunition company announces that its basewads are locked too tightly to permit of this happening.

So far as I know the theory has never been proved, either that the basewad is drawn up the bore of the gun or that it would then burst the gun on the next shot. Deliberate experiments placing wads at various spots in the bore of the gun proved that they were not sufficient to burst ordinary barrels.

What will burst a barrel with beautiful certainty and promptness is the shot charge and wads which might be blown up into the bore by a charge of powder insufficient to move them clear out of the gun. About two grains of bulk powder is sufficient to give this pleasing effect, which might come about through the bungling loading of the amateur cartridge maker or the faulty machine in a factory, such a measure running empty.

The paper-thin walls of a shotgun barrel, burst by an obstruction in the bore

Unless the shooter is very excited, the lack of recoil and noise would notify him that nothing much had taken place within the chamber of his gun at the faulty shot, but he might easily mistake it for merely a misfire, eject the case and fire another shot with the previous charge lodged somewhere in the bore.

It is a highly pious idea for the gunner, finding anything out of the ordinary in his shot to stop and investigate fully. What seemed merely a misfire might easily be a partial movement of the charge or bullet through the bore of the gun and a lodgment therein with the certain results of a wrecked barrel the next shot if not a mangled hand in the case of the shotgun or rifle. The shooter has no business firing another shot after an apparent misfire without carefully inspecting the cartridge or the bore to make sure that nothing undue transpired and this should be invariable, regardless of how plentifully the birds or burglars may be flushing in front of him or how badly he wants to plug the next shot right away without delay.

The right barrel of this double, hammerless shotgun burst in the hands of the owner. The burst in the left barrel was produced in the factory, by dropping in a 20 gage shell and then firing a 12 gage shell behind it. Not much question what burst the right barrel?

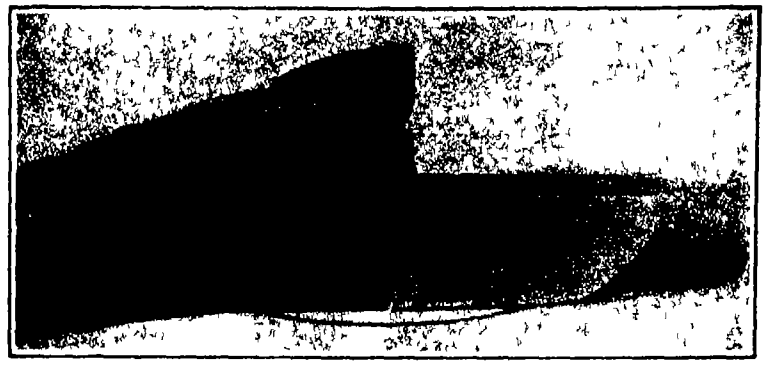
Rarely does a high power rifle develop trouble more than a bulged or burst barrel and not often the latter. The cause is almost always an obstruction which has fallen into the barrel or been left in during the cleaning process. Once in a blue moon a bullet sheds its jacket and leaves it in the bore, to produce a bulged barrel the next shot. This is a rare case but anything unusual in the shot, a failure in the bullet to register or its very wild impact should be cause for seeing that "the hole goes clear through" the barrel before again firing.

Our service rifle has a distressing habit now and then, of utterly wrecking its receiver from the junction with the bore clear back to the tang of the arm. Sometimes the cause is hard to diagnose, but primarily it is due to the faulty design of all bolt action or other type of rifles using rimless cartridges. The bolt cannot in the nature of the case entirely support it around its head and weak brass or undue chamber pressures rupture the case around the head, let out the gas at its playful pressure of 50,000 pounds per square inch, when normal and wreck the receiver at its junction with the barrel.

This of course releases the bolt and generally takes apart the entire mechanism of the rifle as shown by the illustration of one I recently examined. Queerly enough the shooter is rarely injured with all the frightful scatteration of good strong steel parts close to his face. This is a semi-rare happening as proved by the ratio of about one blow up to a couple of million shots fired but when it does occur it is very disturbing to the man who does much shooting with the military rifle.

The chamber pressure of the humble 22 short beloved of the shooting gallery is about 10,000 pounds per square inch of chamber area—four tons. The chamber pressure of the shotgun runs from 6500 to 11,000 pounds per square inch or around three to five tons. The chamber pressure of the various rifles ranges from the short figure of 10,000 pounds to the 50,000 pounds or 25 tons of the service rifle.

If the shooter will keep in mind the fact that he is handling an engine of tremendous internal pressure and power, and not a cane or an axe or an alpenstock, then will those miscreants the gun and ammunition makers be found to be quite human in their ambitions and to be making ammunition and guns far more reliable than dreamed of in the philosophy of the shooter.



This is the weak point of the shotgun frame. Firing both barrels at once, or an overloaded cartridge, will sometimes break it here

Darwin and Evolution

IN an address before the American Association for the Advancement of Science at its Los Angeles meeting in September 1921 Dr. David Starr Jordan said:

"Nothing we know takes place without an adequate cause. Among the attempts to search for causes for phenomena in animal and plant life the most notable have been those of Lamarck and Darwin. Lamarck noted the facts of use and disuse in the development and modification of the individual and suggested that the higher groups must have originated in like fashion. Hence the theory of development through the inheritance of acquired characters, hereditary traits being modified from generation to generation through use and disuse of organs or other causes.

"Darwin went much farther stressing especially the sifting and splitting due to varying environment. These he summed up under the complex term of 'Natural Selection.' He conceived of a 'struggle for existence' with the continued survival of those which could maintain themselves bequeathing their adaptive characters to their progeny.

"There is a recent tendency among biologists to ignore Darwin and his method of approach in favor of more metaphysical conceptions of evolution as unconditioned by environment. The process of induction is slow and laborious that of deduction may be speeded up as demanded. The basal fact remains, the method of Darwin of considering all relevant truths is the only way. The causes are the matters really important."

After emphasizing that the descent of living forms from series now extinct is too obvious for any well informed mind to question Dr. Jordan continued: "We would like to know how this came about. Darwin's work is like a great sketch map which his successors are filling in and in no vital respect will the final chart vary from the ascribed landmarks. Naturalists have found that they can produce in a few weeks by selection and segregation forms apparently as distinct as Nature can establish through similar means in a millennium. But Nature's species are of long endurance and the reason why this is so is a vital problem.

"We know nothing of evolution in vacuo, of change in life unrelated to environment. All forms of life are split up into species with adaptation to external conditions visible in every structure. We know of no way in which organisms become adapted to special conditions except by the progressive failures of those which do not fit. No organism can escape this process.

"To admit these facts and yet say that selection and segregation are not factors in evolution would appear to make the matter a mere question of words. If by evolution we mean the theoretical progress of life due solely to forces intrinsic in organisms, then outside influences are of course not factors in such evolution. If however we mean the actual movements of actual organisms on this actual earth then intrinsic influences and obstacles are obviously factors."

Our Point of View

A Senatorial Inquisition

IF THE possession of a supreme sense of proportion is the outstanding mark of a man of genius, it must be admitted that the recent investigation of the Bok Peace Award by the Senate can scarcely be called a stroke of genius. Indeed we are inclined to think that their amazing procedure indicates that this august body has entirely lost at least for the time being, its sense of humor. Certainly it has lost the sense of the proper scope and limitation of its own prerogatives.

Here is the case of a United States citizen, widely respected and beloved, who, in the endeavor to promote the cause of peace offers a prize for the best essay on the subject. Nothing wrong surely in that. The winning essay out of the twenty two thousand sent in is selected published, and widely distributed. So far so good. When certain of our Senators come to read the essay they find in it a more or less complete endorsement of that to them, most accursed document the League of Nations and forthwith, having constituted a committee these gentlemen proceed to let forth a howl of rage, punctuated with innuendo and vituperation, through which the practised ear can detect a strong undertone of political apprehension. Well there is nothing wrong in that. Politically considered that sort of thing, we suppose, is "perfectly all right."

But when the Senate proceeded to call Mr Bok before its committee and demand that he tell them why he offered this prize and what he spent upon the effort they were no longer perfectly all right but perfectly all wrong. There are among the prized possessions of the people of the United States some most sacred principles known as "the sovereignty of the people" "the freedom of the press," "and the freedom of speech" and this high handed inquisition of the Senate is a direct and most impertinent attack upon these inalienable rights of the American people.

The SCIENTIFIC AMERICAN is not a political journal. We can express no opinion for or against the League of Nations or any similar question but when we see such an audacious interference with the fundamental rights of the individual citizen, we raise our voice in protest. The prestige of the Senate does not stand at such a high level just now, that it can afford to make so amazing an exhibition of itself as it has done in this recent inquiry. We like to hold our Congress in high regard and it positively hurts our feelings to see the smile of amused contempt which the mere mention of this incident seems everywhere to beget.

To the members of the committee who have thus and at last achieved a surely secure immortality, we commend some simple lines of a simple Scotch laddie

"O wad some Pow'r the giftie gie us
To see oursels as ithers see us"

Tremendous!

THERE is fashion in words, as in clothes. Someone or some group of men begin to favor a particular word or it is used in connection with a crisis that attracts nation wide attention. Usually it is a sonorous word and if as in the present case, it carries a sense of the dramatic, so much the better for it is then well launched on the wave of popularity. Not so long ago "absolutely" had its run. Where the simple 'yes' would have served the interrogee would say "absolu u u tely." That lute like third syllable would be held lingeringly on the lips and with evident relish.

Not long ago we drew attention to the vogue which the word 'tremendous' was having and we mildly suggested that it was being tied up with words for which it made but a sorry mate. The fashion is still with us. Writers of all kinds and degrees seem to feel that if an article is not freely sprinkled with "tremendous" it will be wanting in pep.

Now please listen to this. Recently during our editorial browsing, we came across a technical article, compact, well expressed and informing in which the author used the word 'tremendous' no less than nine times. He spoke of a 'tremendous saving of time', a "tremendous capital investment", a "tremendous complexity' "tremendously high speeds", "tremendous power' 'tremendous concentration of power "tremendous difference in results", and, ye Gods! "tremendous refinement!

Now one "tremendous," or two at the outside, should satisfy the requirements of an article of two thousand words or so. But surely the author is not so tremendously full of inspiration that he must use nine tremendous relief valves to let it all out.

Let him therefore write of a *great* saving of time, a *large* capital investment, and a *troublesome* complexity. Let him describe the *intense* concentration of power, the truly *tremendous* power which makes possible such extraordinarily high speeds.

Thereby and with patience he may arrive at an *extreme* refinement of his literary style.

Hope for the Merchant Marine

THANKS to the action of President Coolidge in placing Rear Admiral Leigh C Palmer in charge of the Emergency Fleet Corporation, there is a brighter future in store for the American Merchant Marine. The President has removed the actual operation of the ships from the politicians and placed it in the hands of a practical and very able "sailorman." The significance of the term "sailorman" will be understood when we say that, in the Navy to call an officer "a real sailorman" is to put the last if not the highest, mark of approval upon his qualifications. The Admiral knows a ship from truck to keelson and if he is left alone the vessels of the emergency fleet will be run as they should be. The applicant for position will not be asked "what are your politics,' or "what is your religious faith,' he will not even be asked whether in the late war, he would as soon have fought against the British as against the Germans.

So far, then, as Leigh C Palmer is concerned our costly wartime fleet will be efficiently maintained and operated, but we repeat, this will happen only if the Admiral is 'let alone." But who is to interfere with him? Unfortunately the Shipping Board is in the position to do so. If Mr Coolidge could have had his way, Admiral Palmer would have had a free hand. Evidently the President would have liked to wash out the Shipping Board, or at least place it under this naval officer and give him a free hand in salvaging our fleet and running it on practical lines. Unfortunately, legislation will be needed to abolish the Shipping Board.

So here we have a practical, high-class naval officer subject to a political board whose record is one of incompetence and extravagance, and whose policy of repudiating commercial treaties would render hostile every maritime nation in the world and besmirch the good name and high faith of the United States. The new head of the Emergency Fleet Corporation should be given a free hand. The best way to ensure this is to abolish the Shipping Board altogether.

The Way of a Ship in the Air

A CURIOUS instance of the persistence of habits of thought and point of view was shown in the press descriptions of the so-called "fight" of the "Shenandoah" with the furious storm of wind and rain which tore her loose from her moorings. As a matter of fact, when she broke away, the storm, for her, was over. Like a free balloon, she moved with the moving air. Looking at the airman from the ground, it is difficult to realize that, for him, the hurricane that makes us bend over and brace ourselves to avoid being swept away, simply does not exist. The airman knows no hurricane other than that of his own making. The "Shenandoah" with her engines dead was in dead air. With all engines open she could produce, relatively to herself, a windstorm of 65 miles per hour. Had she driven herself before that 70-mile gale or against it, there would have been not one iota of difference in the stresses to which she would have been exposed.

The writer had an interesting talk with an officer who was in the pilot house when the ship broke loose. He spoke of the loud din made by the flapping of the fabric covering of the ship and the "groaning" of her basket like metallic framework. It sounded alarming at the height of the storm, but it held no threat of danger to the structure of the ship as a whole. He was making some notes on the chart table, when suddenly the racket ceased. All became still. Immediately he knew that she was free from the mast, or to put it in the language of the sea, "her moorings had parted.' That sudden silence—no flapping of canvas—no creaking of straining joints—no roar of the gale—tells the story. So far as "Shenandoah" was concerned, since she was amply furnished with water ballast and gas-venting valves, and had several thousand miles of fuel capacity in her tanks the trouble was over.

Captain Heinen told the writer that, once they had dropped ballast and brought the ship up, he found the rest of the night voyage "very interesting and enjoyable."

Approaching Deadlock in Street Traffic

TRAFFIC on the streets of New York is steadily approaching a density which will involve an absolute deadlock. That is to say, the time occupied in waiting for this line or that line of traffic to get permission to move on will be so great that, to all intents and purposes, we shall have reached the point of positive stagnation.

Should the contending voices, each clamoring for the construction of its own ill-digested scheme of rapid transit, agree tomorrow upon a unified plan, and should construction be begun at once, with all the energy of the city behind it street traffic conditions will have reached the point of deadlock before such plans can be carried to completion.

By far the most important question among the many which make up the problem of getting the ever-increasing millions of people to and from that great workshop which is known as Manhattan Island, is that of connecting the Island with the outlying suburban districts. How shall the crossing of the Hudson River be done? There are two proposals under discussion, one of which would solve the problem by building several tunnels, the other by erecting a single bridge. The latest announcement states that by the time the present vehicular tunnel under the Hudson, with its terminals, plazas, and street approaches, has been completed and opened for service, it will have cost $45,000,000. For this great outlay it will provide in the two tubes for only four lines of traffic. Four such tunnels would provide 16 lines of traffic for a total cost of $180,000,000.

On the other hand, the proposed Hudson River bridge at 57th Street, which also will cost $180,000,000, will provide on its upper and lower decks for more than twice that number of lines of traffic, including motor traffic and rapid transit trains, and in addition it will provide wide pathways for foot passengers. It has been claimed that a bridge of this large capacity would produce great local congestion at its approaches. This is not the case, for the latest plans provide for the construction of a six track elevated automobile and motor car roadway, extending from the entrance of the Hudson River bridge to the entrance of the bridge over the East River at 59th Street.

So excellent is the organization for bridge building, both at the fabricating shops and at the bridge itself, that a bridge even of this magnitude could be completed in five years from the day on which ground was first broken. The tunnels would have to be built successively, and it would be at least ten years before the whole four of them could be completed. Tunnel building is too slow a process; it can never catch up with the city's growth.

Here and There

NO introduction of the name of Madame Curie need be made to our readers. One of the interesting scientific events of recent weeks occurred on the twenty fifth anniversary of the discovery with which this celebrated name is connected. The occasion was dignified by the payment to Madame Curie, in the presence of President Millerand, of the first installment of a pension voted her by the French legislature in recognition of her scientific achievements. In this connection it is interesting to quote the modest title under which her discovery was announced to the Academy on December 26, 1898: "A note by Monsieur and Madame P. Curie and Monsieur G. Bemont, upon a new radioactive substance found in pitchblende." This substance of course, was radium. Our photograph shows Madame Curie in the working garb of her laboratory.

THE thing that we call "sound" is simply vibrations—waves in the air, or in some more solid substance. When these waves fall upon the human ear they give rise to the sensation of sound—with one proviso. The ear is sensitive only to vibrations within a certain range. The faster they come, the higher the 'pitch' of the sound; the slower they come, the lower. But the ear has a lower limit and an upper limit. If the waves come too slow, or too fast—if the pitch is too low or too high—the ear does not respond to them, and we hear nothing.

Now nature in general suffers no such limitation as this. Every day in thousands of ways things happen—the movement of insect wings for instance—which give forth vibrations of far too great frequency to be audible to the human ear. Similarly, in the growth of plants and in numerous other instances, we have phenomena giving off vibrations that are too slow to make an audible noise. We should like enormously to hear these vibrations for they are just as interesting as the ones that come within our range.

We can't hope to hear them directly but Dr. Phillips Thomas, research engineer of the Westinghouse Company, pictured herewith has now made it possible for us to see them, giving us a means for direct observation of many phenomena which have heretofore been quite hidden from our senses. His device consists simply of a ring containing two electrodes, between which plays a glow discharge produced by high voltage. This discharge will respond, in visible fashion, to air vibrations pitched all the way up to a million cycles per second, where the human ear stops at an upper limit of 20,000 per second. Nobody knows just what will be discovered with the new instrument, but it is sure to have broad results. One of the first suggestions is that it will enable the entomologist to observe the methods by which insects communicate with one another—there seems little question that this communication is through "sound" waves that have been inaudible to us on account of their very high pitch.

THERE is fair chance that during this year a flight around the world will be accomplished either by our British friends or ourselves. Aside from the usual question of national pride, it matters little; the successful accomplishment of this feat is rather for the good of aeronautics. What a gruelling test for an airplane! Somewhere between 25,000 and 35,000 miles of travel, facing all kinds of flying conditions, far from machine shops and replacements, so that the fliers will have to depend on themselves, to a great extent, flights over wide expanses of open sea. It will require a sturdy plane and a sturdy engine and a sturdy crew. Little wonder therefore that such a rugged craft as the Douglas Wright biplane shown in the accompanying view, is being considered as compared with the frail biplanes of not so long ago.

WHILE photographing the bombardment of atoms by electrons in his laboratory, Professor William D. Harkins of the University of Chicago whose portrait adjoins these remarks, recently observed an entirely new type of ray. It appears to be a light wave, presumably of a heretofore unknown wave-length and to be given off by minute particles of matter. The discoverer has given it the name Zeta ray and he suspects that it may turn out to have some relation with the problem of getting useful force out of the disintegration of the atom. First announcement of the discovery was made at the recent meeting of the American Association for the Advancement of Science, and was regarded as one of the more important developments of this meeting.

NEWS dispatches of recent date remind us again of the potentialities for destruction lurking in the most innocuous-appearing species of dust. Any finely comminuted matter whatever, it appears is likely to produce a violent explosion given the appropriate conditions. This time the apparently innocent substance that dealt out death to some two-score people was ordinary starch and this produced enough dust to explode in spite of the fact that it had a moisture content of 12 per cent. It will perhaps surprise some of our readers to learn that this is a well recognized hazard; that the accidental production of a spark in an atmosphere moderately laden with dust of any sort is likely to lead to an explosion quite as severe as that of January in Pekin, Ill.

ACCORDING to Dr. Francis C. Wood, Director of the Crocker Institute of Cancer Research of Columbia University, a marked advance in the treatment of this dreaded disease has been made possible by a new type of X-ray tube. The new tube has a higher emissive power; that is to say it is as though the candle-power of an ordinary lamp had been increased six fold. In addition it is designed for use with higher voltages than have been practicable in Roentgenology. The result is to reduce the necessary exposure from two or three hours per patient to twenty minutes and to increase the life of the tubes. Incidentally, the new tube gives a greater proportion of rays of the type that cure certain forms of cancer and less of the sort that attack healthy tissue. Dr. C. T. Ulrey of the Westinghouse Company is the inventor of the new tube. The inventor and his scientific infant are portrayed at the right.

UNDER the most unfavorable conditions it begins to appear, radio reception is possible, or at least may be hoped for with some degree of confidence. Only a few weeks ago, for instance in spite of the enormous masses of grounded steel in the Woolworth Building, a very small and low powered set self-contained, with loop in place of antennae and with no ground at all, functioned fairly well at a demonstration in this office. A day or two later, tests were made to determine whether the radio could be used for the purpose of communicating to men working underground, warning of danger in time to enable their escape. The experiments were carried out in the Hudson Tunnel joining New York and Jersey City. In spite of the fact that the receiving apparatus was under 80 feet of steel concrete, mud and water, the programs of the local broadcasting stations were heard with complete success.

DISMANTLING of the Tutankhamen tomb, with the view of removal and reerection on another site, proceeds but under difficulties. The work is necessarily slow, since elaborate scaffolding must be erected in a very confined space, and the job has therefore to be taken in very small bites or the scaffolding of one part would interfere with the work on another section. Also it is found that some of the tongue-and-groove construction of 3200 years ago was not put up with any idea that it should ever be possible to take it apart without damage; and the effort to do this has in more than one place come perilously close to defeat. This is indeed an engineering problem of considerable novelty; the wrecker of buildings ordinarily works with the primary object of getting the structure down and when in the past he has had to preserve it intact, it has usually been a small affair like a historic log cabin or a monolith like the obelisks from Egypt that now stand in London and in New York. The Carnarvon-Carter expedition is actually making engineering advance as well as adding to our archaeological knowledge!

THERE is something in an organism which determines the location and arrangement of parts—for example a head at one end that tentacles shall arise in a circle around the body; that right and left sides shall be alike. But from time to time something goes wrong with the machinery of this adjustment, and the human or some other animal gives birth to monstrosities and malformations. Progress toward the discovery of the specific causes of such accidents was indicated by Dr. C. M. Child, Professor of Zoology at the University of Chicago in a paper read in Cincinnati recently. Dr. Child told of experiments indicating that variation in the electrical and chemical conditions at different points of the embryo are responsible for the normal divergent lines of development of the various organs, and that alteration of these conditions from the normal is responsible for malformations.

PROLONGED study of the boll weevil by the United States Bureau of Entomology has led to the conclusion that the freshly hatched insects make their way to the cotton field by means of an extraordinarily acute sense of smell. It is inferred that they are attracted by an odor peculiar to the cotton plants and experiments are under way to determine whether this odor cannot be done away with, or imitated in such fashion that the weevils may be lured into traps. The reactions of the insect to the odors of peppermint, wintergreen, honey, citronella and other pungent substances have been tested and the Federal scientists hold out hope of being able to build up a sort of siren's song of odors that shall carry deception to the olfactory organs of the weevils. Incidentally the weevil keeps right on spreading; the only visible result of twenty years' work has been to slow down its expansion. Increasing every year the boll weevil affords graphic evidence that the balance between insects and humans is a delicate one and that a very little thing might exterminate us in their favor.

A Wild Night on the "Shenandoah"

Blown from Her Mooring-Mast, the Ship Weathers the Storm and Is Brought Back to Port

The ship was torn loose from the mast by a heavy gust on the starboard bow. The two forward bags lost their gas

ON THE early evening of January 16 and at the close of a four day test the "Shenandoah" was torn from her mooring mast by a gale of cyclonic strength precisely at the moment when the anemometer at Lakehurst Station registered a wind velocity of over 75 miles. She left her cap on the mast and disappeared in the gloom with a gaping hole in her bow. During the early part of the storm the ship rode comfortably to the mast and no difficulty was found by the quartermaster in keeping her head on to the wind. But the whirling gust which tore her loose evidently had veered several degrees, probably fifteen or more, to starboard and the greater area presented to the wind coupled with the fact that the pull was no longer in the line of the ship's axis but considerably to starboard brought an extremely heavy tensile strain on the lee side at the point of attachment of the longitudinal girders to the nose cap. They parted and the rupture became progressive until the cap was torn entirely out of the ship.

Our photograph of the "Shenandoah" shows that the pull on the cap was to starboard, for as the ship was swept from the mast a long strip of the outer cover was ripped from the starboard side. Moreover the mass of the frame wreckage is to starboard. In some way or other as the wreckage was torn loose the two forward gasbags were ripped and deflated. This loss of buoyancy caused the bow to sink and it was only the quick action of the officers and crew in discharging the forward water ballast and a minute later in dropping two of the forward fuel tanks through the canvas bottom of the ship that brought the bow up and saved it from crashing against the forest trees as she passed out of the flying field. Later in the flight one other tank was dropped.

Thanks to the discipline of the engine-room force the engines were started at once and successively so as to give the ship steerage way and check her speed before the storm. By the time she reached Newark the wind was beginning to moderate and swinging around over Staten Island and towards the coast she ultimately began to work her way back to the hangar where she was safely brought down and housed before daybreak. The control of the ship was greatly hampered, it should be noted, by the fact that the diagonal gust of wind which tore her loose wrecked the upper stabilizing fin and threw the adjoining rudder post out of line.

The good ship throughout that wild night was in command of Lt. Commdr. M. R. Pierce and Chief Engineer Lt. Commdr. J. M. Deem and fortunately Captain Heinen was aboard and was able to draw upon his own long experience of 15 years as pilot. But the reporters of the daily press, urged on by the demand that there be plenty of human interest (which often is only another name for sheer sensationalism) in their work spread abroad a weird story of disorganization and clash of authority between the officers in charge and the said Captain Heinen. That there was excitement goes without saying, for the crisis was sudden and great, but Captain Heinen was too well versed in the discipline of the sea and the air not to know that he was aboard in a consultative capacity only. It is needless to say that, because of his long experience, he was invaluable in the emergency.

The public has been given the impression that the actual peril to the "Shenandoah" came when she broke adrift. This is not so. Except for the sinking of her bow, which was quickly remedied, she was under much less stress after she broke free than she was at her mooring. Before that she was a rigid object in a great stream of wind that was rushing by her at 60 to 70 miles an hour. As soon as she broke loose she began to float with the wind and quickly assumed the same velocity. When that condition was reached there was but little more wind strain upon the ship than if she were floating on a breathless summer day above her flying field. So accustomed are we dwellers upon *terra firma* to refer everything to mother earth that the average layman finds it difficult to realize that once an airship is free of the ground there is for him no longer any wind velocity. Hence through all the long and stormy night which seemed so terrific to us, the "Shenandoah" was floating quietly, unbuffeted and unstressed and, except for her damaged bow and stern, was able to turn herself to her home port as easily as though there were a dead calm.

This umbrella-like structure is the nose-cap, which was torn out of the ship and left hanging from the masthead

The difficulty of navigation came from that badly torn bow and still more from the completely wrecked upper fin and the bent rudder post. It is greatly to the credit of her navigating officers that she was able to work her way home to a safe landing without tearing off more of her canvas covering and wrecking some more of the exposed forward gas bags.

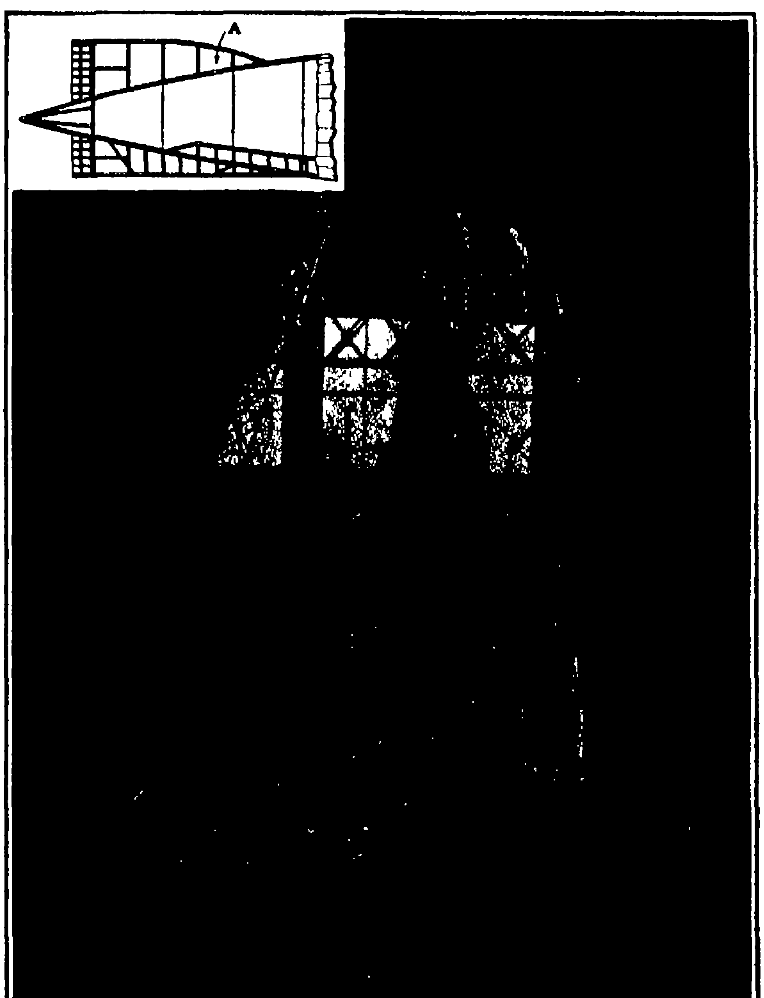
Let it be clearly understood that both the mooring mast and the ship came bravely through the ordeal. The mast, which is an extremely strong and stiff structure, stood up to its work. The tearing away of the nose-cap does not by any means prove that no airship can ride out a storm even of cyclonic strength at her mooring. On the contrary we believe that by distributing the stresses evenly over a larger area of the bow of the ship it would be possible to hold her intact even when she is struck such a sidewise "swipe" as tore the "Shenandoah" loose.

Perhaps the most interesting of our pictures is the view taken from within the forward portion of the upper stabilizing fin looking aft towards the vertical rudder post. It certainly shows a very sorry wreck and demonstrates the dynamic force with which the cyclonic gust struck the ship throughout its whole length from bow to stern.

The fin that was wrecked consists of a series of A frames, the tallest 25 feet in height, built upon the extreme end of the ship. They are tied together and kept in place longitudinally by the ship's structure below and above by a longitudinal girder extending from apex to apex until it reaches the vertical rudder post astern.

Because of its height and comparatively narrow base the fin structure has always been more or less of a constructional problem. It was difficult to hold it in line and the Germans gave a good deal of thought to the design. As can be seen from the photograph the dimensions are large, and it proved difficult to hold such a big surface rigidly above the narrow and comparatively frail base. Although the fin is sufficiently strong while it is being drawn parallel with the air stream manifestly it is not well adapted to withstand a side blow such as tore it apart in the recent gale. It will be noted that, yielding to the pressure, two of the A frames were pushed over to the port side, one of them being broken apart at its apex. They are carried upon shallow, double A frames built upon the circular frames of the ship, and in each case the port leg of the upper A frames crushed in the structure below. The top longitudinal, as the fin was bent out of line,

(Continued on page 207)



This view was taken within the wrecked fin at point A, looking aft. The heavy quartering gust that tore the "Shenandoah" from the mast struck the fin, canted the frames to port and ripped away the fabric

Our Abrams Investigation—VI

A Study of the Late Dr. Albert Abrams of San Francisco and His Work

By Austin C. Lescarboura

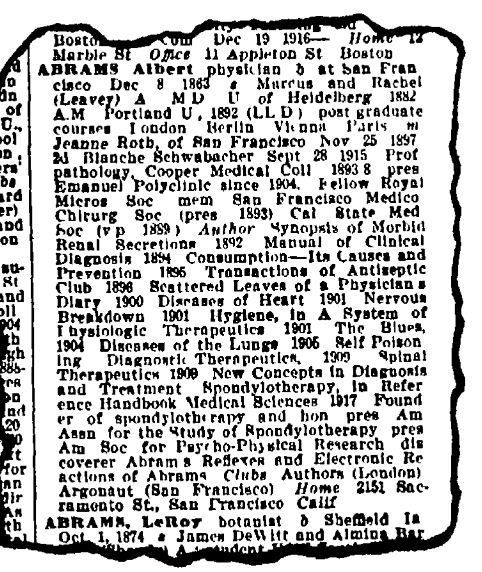
Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

DR ALBERT ABRAMS is dead He passed away suddenly on Sunday, January 13 from an attack of pneumonia, on the very eve of his scheduled appearance as the star witness in the trial at Jonesboro Ark., of Dr Mary Lecoque, an E R A practitioner charged with using the mails to defraud The Government alleged that the Abrams practitioner in this case diagnosed the blood of a chicken as that of a human, and offered a cure after the specimen had been sent her through the mail This trial was one of several disagreeable events confronting Dr Abrams and no doubt weighed heavily on his already over taxed mind and health

It is fitting at this time that our investigation be directed towards a study of Dr Albert Abrams who, after all is said and done was the mainspring of the entire E R A technique To this day the basic facts of E R A remain unproved, so far as the scientific world is concerned and those who have accepted the E. R. A. technique have done so largely on their faith in Dr Abrams Indeed, in our constant and unrelenting efforts to obtain some evidence of the basic phenomenon on which this entire structure of queer ideas and still queerer practice rests we have always been referred to Dr Abrams Individual E R A practitioners, despite their every day use of this method in making diagnoses and giving treatments to their patients, have declined to submit themselves to our tests but have preferred to have us deal directly with Dr Abrams. Then, when we have tried in every possible way to make some kind of test with Dr Abrams which would immediately prove or fail to prove his basic claims, we have found Dr Abrams quite unprepared and obviously unwilling to aid us in our sincere quest except under his own unscientific conditions

Let us study the late Dr Albert Abrams not only as an individual but more particularly as the foundation of the E R A idea If anything he was E R A personified and one begins to wonder whether this technique can be as effective now that Dr Abrams is gone However that remains to be seen

According to "Who's Who," the clipping from which is herewith reproduced, Dr Albert Abrams was no ordinary man His degrees were extensive and he was quite proud of them His letter head and his literature never failed to give all his degrees and titles and in this as well as in many other ways, he went pretty far astray in the matter of professional ethics, particularly those of the medical profession That he was an indefatigable worker we cannot deny He wrote many books His record shows a constant striving for something new He took a keen interest in X rays when Roentgen's discovery was announced, just as he took a keen interest in the electronic theory He became interested in chiropractic, osteopathy, and other kinds of therapeutics, aside from the orthodox medicine in which he received his original training and experience In fact, this fascination for something new and his inventive type of mind caused him to develop various techniques culminating in the Electronic Reactions of Abrams. It is not strange, then, that for greater freedom of action he resigned from the orthodox medical fraternity


Boston ... Com Dec 19 1916— *Home* 12 Marble St *Office* 11 Appleton St Boston
ABRAMS Albert physician b at San Francisco Dec 8 1863 s Marcus and Rachel (Leavey) A M D U of Heidelberg 1882 A.M Portland U, 1892 (LL D) post graduate courses London Berlin Vienna Paris m Jeanne Roth, of San Francisco Nov 25 1897 2d Blanche Schwabacher Sept 28 1915 Prof pathology, Cooper Medical Coll 1893 8 pres Emanuel Polyclinic since 1904. Fellow Royal Micros Soc mem San Francisco Medico Chirurg Soc (pres 1893) Cal State Med Soc (v p 1889) *Author* Synopsis of Morbid Renal Secretions 1892 Manual of Clinical Diagnosis 1894 Consumption—Its Causes and Prevention 1895 Transactions of Antiseptic Club 1898 Scattered Leaves of a Physician's Diary 1900 Diseases of Heart 1901 Nervous Breakdown 1901 Hygiene, in A System of Physiologic Therapeutics 1901 The Blues, 1904 Diseases of the Lungs 1905 Self Poisoning Diagnostic Therapeutics, 1909 Spinal Therapeutics 1909 New Concepts in Diagnosis and Treatment Spondylotherapy, in Reference Handbook Medical Sciences 1917 Founder of spondylotherapy and hon pres Am Assn for the Study of Spondylotherapy pres Am Soc for Psycho-Physical Research discoverer Abram's Reflexes and Electronic Reactions of Abrams *Clubs* Authors (London) Argonaut (San Francisco) *Home* 2151 Sacramento St., San Francisco Calif
ABRAMS, LeRoy botanist b Sheffield Ia Oct 1, 1874 s James DeWitt and Almina Bar...

Clipping from "Who's Who," giving the brief life history of Dr. Abrams

Such an active man as Dr Abrams was bound to be well known in medical circles long before he became famous through his electronic reactions As far back as 1887 he was professor of pathology at the Cooper Medical College. He was connected with the Emmanuel Polyclinic and other institutions, and as a practicing physician in San Francisco he enjoyed a wide clientele His diagnostic skill was often sought by other physicians and particularly surgeons, even when he was still using more or less orthodox methods His writings attracted a good deal of attention on the part of doctors and no little controversy But it was not until Abrams announced his discovery of the electronic reactions and their applicability to diagnosis and treatment that he became a great influence in medical circles He surrounded himself with several thousand practitioners who took up the E R A technique, and these practitioners in turn converted tens of thousands of laymen to this new idea And all the while the basic phenomenon has never been established in a scientific way despite the bold fact that E R A claims run counter to our present day knowledge of physics

The late Dr Albert Abrams of San Francisco, originator of the E R. A technique

That briefly, is the really wonderful feature of E R A It claims to do remarkable things as a matter of every day routine The E R A practitioner to all appearances is enabled to diagnose the state of health of any individual from the blood specimen of that individual or even from the handwriting He can determine not only the present diseases and ailments but also those diseases and ailments which may develop in the future, and which are now present in the incipient stage and impossible of detection through orthodox methods even including pathological examinations and X ray explorations He can if he is as competent as Dr Abrams was determine the religion of the individual from the blood specimen He should be able to locate the individual at any given moment He should be able to tell the nationality of the individual and many other pertinent facts always from the drop of blood or the handwriting alone But—should a scientific body such as our investigation committee endeavor to make a simple test which would prove once and for all the basic truth of this bizarre procedure, we are immediately informed much to our surprise that such a request is unreasonable We are asking too much! Even Dr Abrams expressed his surprise at such a request

So the wonderful feature of E R A is that it has been accepted without any proof whatsoever of its basic truth Of course E R A men will hasten to deny this allegation, but our answer to them is that we are prepared to retract this or any other statement we have made at any time after they have come forward and proved to us that we are misinformed By proof, obviously, we mean real proof A simple test means more in the way of proof than hour after hour of mere vaporings, and page after page of meaningless correspondence Already we have had too much of this kind of cooperation from them and too little of the real and serious cooperation which we had every reason to expect from them if they were sincerely anxious to establish their case before the world

All of which is by way of showing how Dr Abrams single-handed was able to gather about him several thousand doctors and near doctors how he was able to attract to his own clinic and to the offices of E R A. men tens of thousand of everyday people seeking relief from their ailments how he was able in the eyes of a large number of people to discredit established medical science how in view of the mysterious workings of his ridiculously crude apparatus coupled with the human reagent he was able to make us wonder whether after all our great scientists like Millikan Einstein Edison and others really did know what they were talking about how he was able to work up his followers to practically a religious fervor in which state they do not hesitate to curse anyone who does not immediately fall in line with their own beliefs All this he did and more too without being obliged to give the world any real proof Truth to tell, he *could not* and *knew he could not* give the world a clean-cut scientific demonstration He admitted as much to those whose names through their unbounded enthusiasm and strong endorsement were closely linked up to his

It may be, although it now seems rather doubtful that Dr Abrams did come across some mysterious characteristic of the human body and that in a crude, blundering sort of way due to insufficient scientific knowledge and training and lack of precision apparatus he was unable to master what he had discovered Such a statement on our part is most charitable but then our entire attitude has been highly charitable We have continued this investigation long beyond the point justified by the plain facts in the case Other investigators long ago would have rendered an adverse opinion based on the ridiculous claims made for this technique the total lack of proof and the refusal of E R A to submit their claims to fair tests, But we have been fretful lest after all, somehow, somewhere there be something basically true and wonderful in this Abrams mystery, and that by rendering an adverse opinion we might be robbing the world of something vitally important Furthermore, we have kept and we continue to keep in touch with E R A men and their work so that there may be no repudiation of our final findings, on the grounds that we did not give them sufficient time to prove their case Our decision *must be* and *will be* final

And the foregoing explains why we have been so lenient We have overlooked many things—superficial things of no real scientific significance Unlike other investigators we have not been influenced by the ethics of certain E R A. practitioners We have not been influenced by numerous E R A failures and individual exposés We have not been influenced by the unfavorable legislative measures which are threatening to terminate E R A practice in various States We have not been influenced by the reports of the American Medical Association, for they are obviously an interested and biased party We have not been influenced by the contracts and the rental rates and other commercial aspects connected with the leasing of the Abrams apparatus to individual practitioners We have not been influenced one bit by the general unsatisfactory aspect of the entire matter from an investigational standpoint Instead, we have gone right ahead keeping in touch with various E R A men, with Dr Abrams with certain so-called electronic societies, and with several individuals who claim to be engaged in serious research work for the purpose of extricating the basic discovery of Dr Abrams from its awful entanglement of handicaps and placing it on a firm and reputable and

(*Continued on page 207*)

"Thirty Years of Psychic Research"

Richet's Monumental Compilation, and Schrenck Notzing's Story of His Work with Eva

Reviewed by J. Malcolm Bird

SELDOM, in the presence of a book to be reviewed, have we suffered so keenly the feeling of inadequacy as at this moment, while fingering the keys of our machine in search of a good jumping-off place from which to introduce our readers to Richet's Thirty Years of Psychical Research. Never have we found it so wholly the case that the only adequate review would be to present the author's entire text. No series of quotations of Richet's high spots, no selection of passages for endorsement or controversion, be they ever so skillfully strung upon the thread of editorial comment would do this volume justice. We shall therefore forego this traditional technique of the reviewer, and so far as is possible in the space available, we shall try to give a concrete idea of the contents of the book.

Richet has been for many years the senior member of the Department of Physiology at the University of Paris. His repute in the field of psychic research is no less than in that of orthodox science. Obviously he brings to psychic research an unusual knowledge of the normal possibilities of the human mechanism. What he now attempts with signal success, is to give us a text book of psychic science. 'I have confined myself,' he tells us, 'to a statement of facts and discussion of their actuality, not only without advancing any theory, but scarcely mentioning theories, for all theories yet proposed to account for these facts seem to me terribly frail.' This aim he executes with great skill and without giving the book any of those formidable aspects or those possibilities of tedium which the use of the term 'text book' might imply. In one respect, however he does not live up to his promise to keep off the grass of theory. He does not advance any theory of his own, to be sure, but he does, at every opportunity make faces at the spirit hypothesis. This he regards as in herently absurd, as well as totally unnecessary, and he loses no opportunity to say so in varied and vigorous words.

One not acquainted with Richet's standing as a scientist, and prone therefore to imagine that he may have established a lower standard of verity for his psychic facts than would be permitted in more conventional branches of science would be disarmed by the chapter in which he discusses the role played by conscious and unconscious fraud of all types, by mathematical probabilities and accident, and by observational error. Throughout the book too, Richet continually meets such a critic on his own ground by making, himself, any unfavorable judgments which are called for by the conditions of observation or of reporting surrounding the cited facts.

Putting the Facts in Their Places

Though the task of the book is thus primarily to summarize the evidence it makes a further contribution than this. It does not, to be sure, attempt any theorization. But it does aim to present the facts in such fashion that the nature and content of the subject matter shall be less vague than heretofore. The classifications into which Richet groups his data, and the names which he manufactures for many of these categories are themselves a large contribution toward the lucidation of psychic science.

The same large division of the psychic field into subjective and objective that all of us make Richet must make too. Within the subjective field he coins a term of great utility. It is quite plain that, when writing automatically speaking with automatic voice, seeing clairvoyantly or hearing clairaudiently etc etc., there are two entirely different aspects to be considered. The anatomical machinery of the voice or the pen, the subjective apparatus of the vision, hallucination, or what not, constitute one of these. The question how there came within the physical shell of the sensitive's brain, information which does not normally belong there is the other and quite other. Richet postulates, from his array of facts that 'human intelligence includes a special and mysterious faculty which reveals certain facts—past, present or future—that the senses are unable to supply." To this faculty he gives the self defining name "cryptesthesia." This includes practically the entire range of subjective phenomena, considered from the side indicated. It certainly includes telepathy, and Richet gives an admirable discussion of this point, the extent to which telepathy alone is sufficient to account for all the facts, etc. He also indicates the phenomena of normal psychology having resemblance to cryptesthesia, and he gives a very complete discussion aimed at ruling out the possibility that everything cryptesthetic can be accounted for on the basis of extreme hyperesthesia of the ordinary senses.

Hallucinations and "Hunches"

Cryptesthesia, he tells us, is classifiable into two broad categories—experimental and "sporadic" or as we should prefer to say spontaneous. He cites a large number of experiments tending to show a certain cryptesthetic faculty in normal individuals—experiments in systematic guessing in which the results were anywhere from twice to ten times what they should have been through pure chance. He then discusses cryptesthesia under actual hypnosis, and under the conditions of the spiritualistic seance. A special category is reserved for 'cryptesthesia by sensitives' under conditions not those of the seance room—psychometry, crystal gazing, and the like. For some reason, though automatic writing gets no special mention as such, being mentioned only as is convenient, in connection with its purely cryptesthetic aspects, "xenoglossis," or vocal use of a language never learned by the sensitive is given a place of honor as a distinct phenomenon. The evidence of its occurrence, however, Richet judges—with apparent reason—to be of low grade.

Coming now to the spontaneous side of cryptesthesia, Richet finds that these monitions, of one sort or another, are of such rich and varied occurrence as to justify giving up 100 pages—out of 626—to them. He discusses quite fully the criteria which must be applied before a monition may be recognized as such, rather than as mere chance. The conditions under which they occur and the symbolical form taken by the present ment are analyzed. The outstanding monition is, of course, that of the death of a friend or relative—more usually, in the literature, referred to as 'death time hallucinations.' Richet, however, makes three other important groups: collective monitions that are non simultaneous and non identical, simultaneous and collective monitions, and non-collective monitions other than those of death.

These monitions, of course, take various apparent objective forms such as the auditory or visual hallucination, the strong sense of presence or of disaster to the object, etc, etc. Richet separates them strongly from *premonitions* and rightly, for the monition implies nothing more serious than clairvoyance, while the premonition, if verified in a sufficient number of cases to avoid the possibility of chance, ranks as outright prophecy. We find that in spite of their more critical character, Richet is able to spread some fifty pages of premonitions upon the record.

The Significance of Prophecy

This might raise the question whether we should regard these predictions as cryptesthetic or whether that term should be reserved for manifestations that involve no looking into the future. There would be some ground, we think for the latter course. It might well be argued that ability to divine what is going on at a remote place, now, or what went on at such a place in the past, is by no means so startling as the similar ability projected into the future—or at least, that cryptesthesia regarding present and past will perhaps yield to an explanation which will not unravel cryptesthesia of future events, and that pending full explanation of both we ought to separate them. Richet, however, defines cryptesthesia for the most general case possible—he makes the past, present or future quality of the event a matter of indifference. In this he is perhaps swayed by some such idea as has come into the editorial mind with reference to prevision. Our spiritualistic friends have often granted that there is no serious objection to our preference for the telepathic hypothesis, so long as ordinary evidential material is considered, but have insisted that prophecy forces us into the spirit hypothesis. We have always replied that it must be proved, rather than assumed, that a dead man can do anything which a live man can't do, and that until this is proved, we are going to insist that, if a spirit can prophesy, a living human can prophesy too, and in quite the same way. On this basis, we agree with Richet in his refusal to put premonitions into a package all by themselves. If they occur, they occur, but they do not, as is so often assumed, lean toward any particular explanation, any more than does any other type of cryptesthesia.

The Objective Half

Passing from the subjective to the objective, Richet finds that the field has been rather more fully covered before him than in the subjective case. Under the heading of telekinesis he groups table movements, noises, and raps, and direct writing. A separate category, for no good reason that we can see, is made for levitations. The ectoplasmic phenomena of materializations, of course, require such a category. Richet's citations show that there is more involved in "bilocations' than might be imagined—the simultaneous appearance of a person in two places, the existence of 'doubles," etc, and he makes out a case justifying the separate cataloging of this manifestation. Whether haunted houses are a separate thing as he makes them, or a combination of his other groups of objective phenomena might be questioned. Richet's summary of the evidence throughout the objective half of the field is of equal value with his summary of the subjective evidence, but he makes no such suggestive a contribution to the machinery of discussion. We can do no better for Dr Richet than quote the opening sentences of his chapter of summary and general conclusions.

"I have now reached the end of this long investigation. I have endeavored, while giving a place—possibly too large a place—to my own researches, to collect the documentary evidence so widely scattered in many records, and to put some order into a matter which up to the present has never been synthetically studied. I have tried to extricate the sciences anathematized as occult from the chaos in which they were involved, and to put in a clear light knowledge that official science, in the pride of its reputation, has refused to consider. It has seemed to me that the time has come to claim for psychic science a place among recognized sciences by making it conform to the rigor and the logical treatment which have given them their authority.

It has appeared to me, as doubtless it will appear to every impartial reader, that there are too many well verified facts and rigorously conducted experiments, that chance or illusion or fraud should always be attributed to all these facts and experiments, without exception."

Anyone who has not brought to this subject the will to disbelieve, who has not made up his mind in advance in the sense decried by Richet, will enjoy the book, in spite of its length and its rather formidable title. And after it has been read, it will be found an enormously valuable psychic encyclopedia and bibliography. Practically all the respectable evidence is here, and in every case there are citations of the sources.

Schrenck Notzing and Eva C.

Of different character is the other outstanding contribution to the psychic literature of 1923. "Phenomena of Materialization," by the Baron von Schrenck Notzing, is the record of the author's four years' work with the French medium Eva C. Every sitting is described in full detail, and there are 225 photographs, practically all of them seance-room flashlights. The

(Continued on page 214)

THERE is no monopoly in psychic research. While the SCIENTIFIC AMERICAN *has been making its contribution, other people and other bodies have been making theirs. Space forbids our giving detailed accounts of other work than our own. But this month we enjoy a hiatus in our own work, and we are very glad to fill the gap with this review of the two books which we regard as the most significant additions of recent months to the field of psychic literature.*—THE EDITOR

When Beavers Aid Irrigation

Emergency Use of the Water Impounded by the Industrious Animals

By Ivan E Houk

THE natural trait of beavers to build dams for the protection of their homes has long been known, but it is only recently that its economic value has been recognized in irrigation work The United States Forest Service, in a recent survey of the Cochetopa National Forest, near the San Luis Valley, Colorado, made by Fred Agee, United States forest supervisor of Salida, found that the water stored above the dams in that forest alone amounted to 1241 acre-feet, that is, enough water to cover 1241 acres one foot deep—the equivalent of 24,000 Colorado statute inches running for 24 hours, or enough to irrigate 30,000 acres of land for one day

Mr Agee's survey, which was carefully and thoroughly conducted, showed that in the Silver Creek Valley alone, 46 dams were located in a total length of about 5¾ miles. These dams averaged about 600 feet apart, although they generally occurred in groups with a somewhat closer spacing In some cases the water was backed up above the dams to depths as great as 5½ feet If these structures had been built of concrete by man and the concrete had cost $5 per cubic yard a very conservative estimate the dams would have cost from $11 to $1026 apiece, and their total cost would have been about $10 000 This is for the Silver Creek Valley only Considering the entire Cochetopa Forest the total cost of the beaver dams on the same basis, would be about $200 000

Consequently it is evident that the value of the beaver as an aid to irrigation is of no minor importance In fact a plan has already been developed and put into operation in Colorado, whereby beavers are taken from one section of the State where they are plentiful and transplanted as it were to other sections where their services are more essential, the animals being trapped in huge wire nets placed on the dams One case is recorded where a rancher, who had only enough water to irrigate a small garden plot before he imported beavers now has sufficient water to cultivate forty acres successfully

The plan followed is to save the beaver storage until late in the summer, when water is scarce and crops are badly in need of moisture then to cut the dams and allow the water to drain into the irrigation ditches Within 24 hours the beavers have the dams repaired so that they are again storing water for another emergency Thus the beaver storage can be utilized several times in one season if necessary

Beavers build their dams of trees, bushes, sticks, weeds, and so forth cementing the materials together with mud and rocks Beaver dams 600 feet long and flooding many acres of land, have been found in northern Wisconsin Sometimes, after years of work the dams become solid banks, through which the water passes only by percolation and on which trees, such as poplar, willow, and birch, take root and grow If this occurs where the natural slope of the stream bed is comparatively flat, marshy ponds and even peat bogs are formed

Beavers bring trees down by cutting around them with their sharp, tough incisors, in practically the same way the woodsman does with his axe One instance has been recorded on the upper Missouri where a tree 30 inches in diameter was felled by beavers They strip the trees of their branches then cut the trunks into lengths of about three feet and store both branches and trunks near their homes for their winter's food supply placing them at the bottom of the pond and weighting them down with mud and rocks In the summer they live on roots berries leaves and aquatic plants but in the winter they eat of the bark of the trees they cut down during the autumn One carefully watched colony of beavers gathered 732 sapling aspens and several hundred willows for one winter's supply placing them in a pile over 3 feet deep and 124 feet in circumference After they have eaten the bark they use the wood in building and repairing their dams That is the reason the most of the logs and sticks in the accompanying views are bare

Beavers prefer the bark of deciduous trees, such as the aspen and willow, trees which are of little value as timber Pine they never attack Consequently they are of some added value to the agriculturist in that they tend to rid the country of weed trees They are strictly vegetarians as they never eat meat of any kind

Beavers seldom work in the daytime but are constantly on the job at night especially moonlight nights, repairing leaks and improving their structures The rapidity with which they work is almost marvelous and their ingenuity in selecting suitable sites for their operations can hardly be improved upon by competent engineers Their dams are invariably located at the most advantageous sites In fact their efficiency in repairing leaks under water is so high that they have been used as a last resort in stopping leaks in man built dams

Beaver dam alongside hardscrabble road in San Isabel National Forest, Col When these dams occur every few hundred feet along the stream, they impound an appreciable supply of water

Beaver huts and beaver felled trees, note the neat cleavage, and the similarity to axmen's work

Elasticity and High Speeds

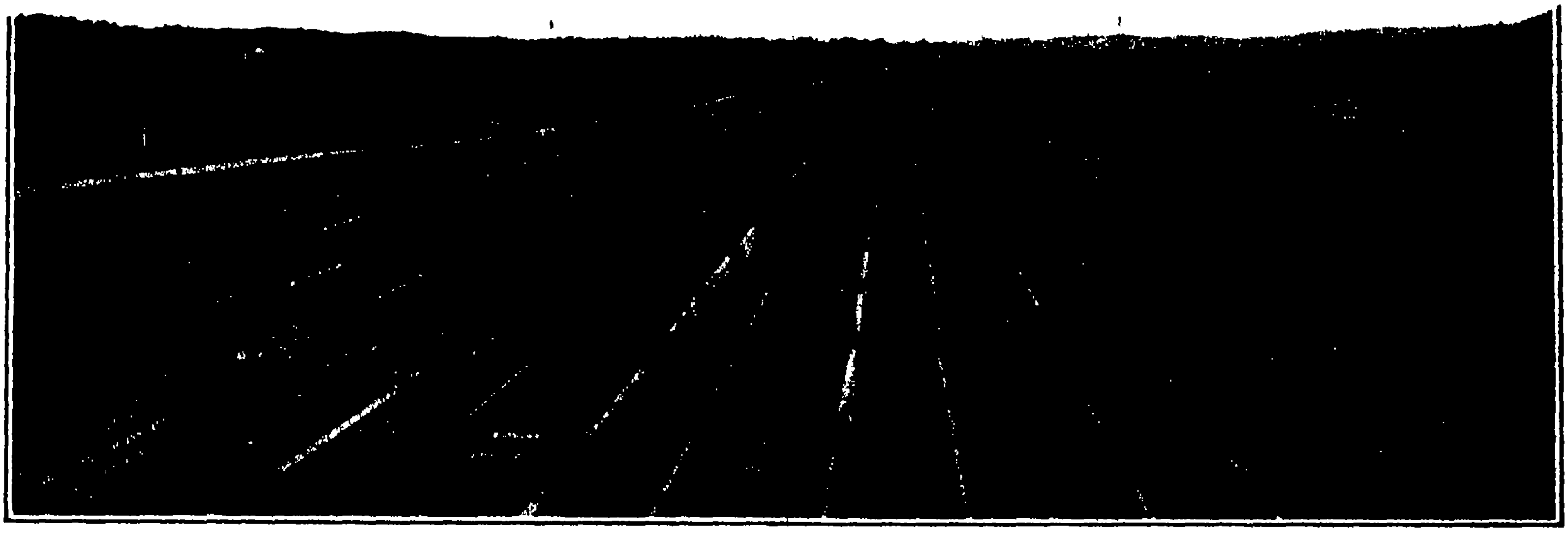
IT is surprising how few men appreciate the importance of elasticity at high speeds and fewer still are able to make their designs so as to avoid trouble When the ox was the principal means of locomotion no springs were necessary The man who invented the bow and arrow was able to produce higher speeds than any before used by utilizing the elasticity of the wood Many designers of limited ability are able to succeed by making things too strong This works all right in many cases but not always The writer has before him now a case where the design of a turbine supporting steel framework was made very heavy by some one who thought that the best way to avoid vibration The result was that the rigidity of the steel was just right, in connection with the weights supported to tune in with the turbine speed and excessive vibration resulted from the combination

To determine the critical speed calculate the deflection of the spindle or beam or the compression of a column due to the weight of the parts and all attached parts If the deflection is 1/360 inches 3600 will be the critical speed (This last is a very common speed and the figures being the same they can be remembered) Do not forget however that figuring the deflection due to weight is only a convenient way of getting the answer for vibration has nothing to do with gravity and it can take place horizontally as well as vertically so it is wise to go through calculations for deflection as if gravity did act horizontally For other deflections the speed will vary inversely as the square root of the deflection Thus for 1/90 inches the critical speed is 1800 revolutions

For steel it is customary to figure 30 000 000 as the coefficient of elasticity There are certain conditions however where we have found that this figure is greatly different Bulletin 219 of the Bureau of Standards gave us a hint in this direction but even the men who made the tests recorded in that Bulletin did not realize the importance of the results They doubted their accuracy and were unable to realize why they differed from results obtained by others We have proved that in cases where the forces are all or mainly tension speeds are high and metals are warm the modulus of elasticity for steel may be below 10 000 000—*By A J Kasley Westinghouse Research Dept*

The Story of Steel—III

The Ore Ship of the Great Lakes; the Link Between the Iron Mines and the Smelting Furnaces



In this great yard, 2½ miles in length, are 96 parallel tracks. Here the ore cars are automatically weighed and reassembled, according to the character of the ore, for shipment to the ore docks. This yard has handled 22,000,000 tons in a single season

WERE it not for the existence of the Great Lakes the vast mines of the Missabe would be an asset of questionable value. To produce steel cheaply you must have abundant supplies of three things: iron ore, coal and limestone. Moreover, they must be available in enormous quantities and located reasonably near to one another. It is for this reason that steel works, the world over, are to be found in the vicinity of coal and iron ore or are so located that the raw materials can be brought to them at a reasonable cost of transportation.

Now the Lake Superior iron mines are grouped around the westerly end of Lake Superior, and at a distance of from 800 to 1000 miles from the coal fields. If the iron ore had to be hauled that distance by rail the cost would be prohibitive. Fortunately when nature ages ago prepared the ore beds of the Missabe range, she grouped them within easy reach of that magnificent body of fresh water known as the Great Lakes. It merely remained for man to develop the proper methods of handling and the right kind of ship to bring these vast deposits cheaply to the storage yards of the blast furnaces. The present chapter in the story of steel shows how cleverly and on what a vast scale this has been done.

The largest tonnage of ore moved over the Great Lakes in a single season was during 1916 when 64,734,108 gross tons were carried through the Lakes. For a comparison of the cost of moving this tonnage let us take the year before the war, 1913, and let us consider the Lake Shore Railroad which, because of its easy grades and fine roadbed, is ideal for cheap transportation. In that year the freight rate was 5.29 mills per ton mile. In the same year the freight rate per ton mile on the Great Lakes was 0.68 of a mill. Of course the charges both for steamer and rail have gone up, but they have advanced proportionately and the relative cheapness as between steamer and rail holds good today. These figures show what an absolutely necessary link in the vast steel industry of the United States is that thousand mile stretch of water between Duluth and the steel works on the southern shores of Lake Michigan and Lake Erie.

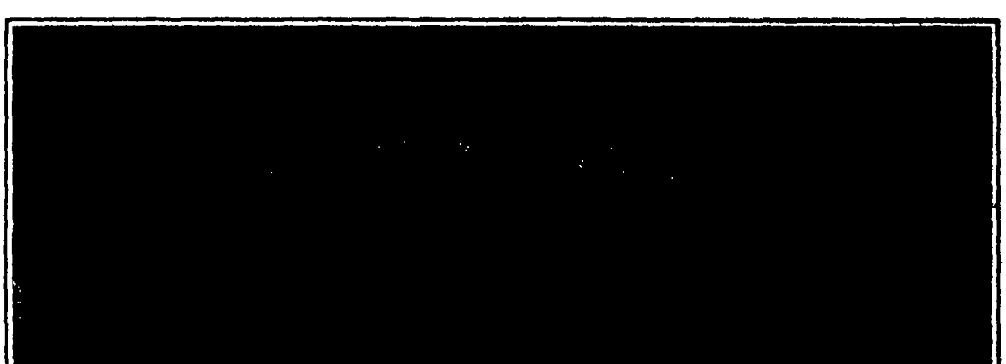
In our last issue we showed how by the combined use of the steam shovel and the ore train, there was shipped out of the Hull Rust Mine alone, in 1916, a total of 7,665,611 tons of ore, and that the total output from all the mines of Lake Superior was 62,816,172 tons. It is the purpose of the present story to show how this vast tonnage is brought down from the mines to the ore docks, transferred without delay to a great fleet of ore steamers, carried through the Lakes, and unloaded at or near the various steel works in the lower Lakes.

Emergency dam above "Soo" locks. Should a lock gate be carried away, this bridge is swung across the entrance, its vertical wickets (steel plates) are lowered and the rush of water checked

At the Hull Rust Mine, which is the property of the United States Steel Corporation, the ore cars, as they are hauled up out of the pit, are made up into trains which average 98 cars, or 4800 tons of ore, per train. As soon as a train is made up, it is dispatched over the magnificent roadbed of the Duluth, Missabe, and Southern Railway Company for the run to the docks at Duluth. Although this is a freight railroad it is built with 100-pound steel and, in part, with steel ties, and it is maintained in as fine condition as any main trunkline track running out of New York. Here again, nature has favored the steel industry, for the first 70 miles or so of the trip is across a practically level country. The speed of the ore trains is from 25 to 30 miles an hour. They are dispatched at the rate of 30 trains per day, although the writer was told by Mr. W. H. Hoyt, Chief Engineer of the road, that on some days as high as 36 trains have hauled a total of 174,000 tons of ore per day from the mines to the classification yard at Proctor.

It should be explained that the cars of ore are sampled at the mines as soon as they are loaded. The samples go to a chemical laboratory and the distribution of the cars is telephoned from the laboratory to the main scale office at the Proctor Yard, near Duluth, before the train reaches that point. As the trains enter the yard, the cars pass over automatic scales at a speed of two miles per hour. The scales operate automatically, the weighing device itself stamping the gross weight of the car on a card as it passes over the scales. At Proctor the trains are broken up by sorting engines, and the ore from different mines is placed together in train loads, so that when the ore is being shipped through the ore pockets and into the boats, certain definite mixtures of ore are built up, carrying the percentages of iron, silicon, phosphorus and sulphur required at the particular furnaces where the ore is to be smelted. To handle this enormous tonnage, the Proctor Yard has been built with 96 parallel switching tracks. It is 550 feet wide, in part, and 2½ miles in length. We present a view showing only a small section of the yard, with 14 trains standing side by side. The mixing of the ore above referred to is revealed in this picture by the difference in the shade and in the fragmentation of the ore. From the yard the ore is taken down to the docks over six miles of 2 per cent grade, by large Mallet engines with 415,200 pounds weight on the drivers.

Nowhere in all America

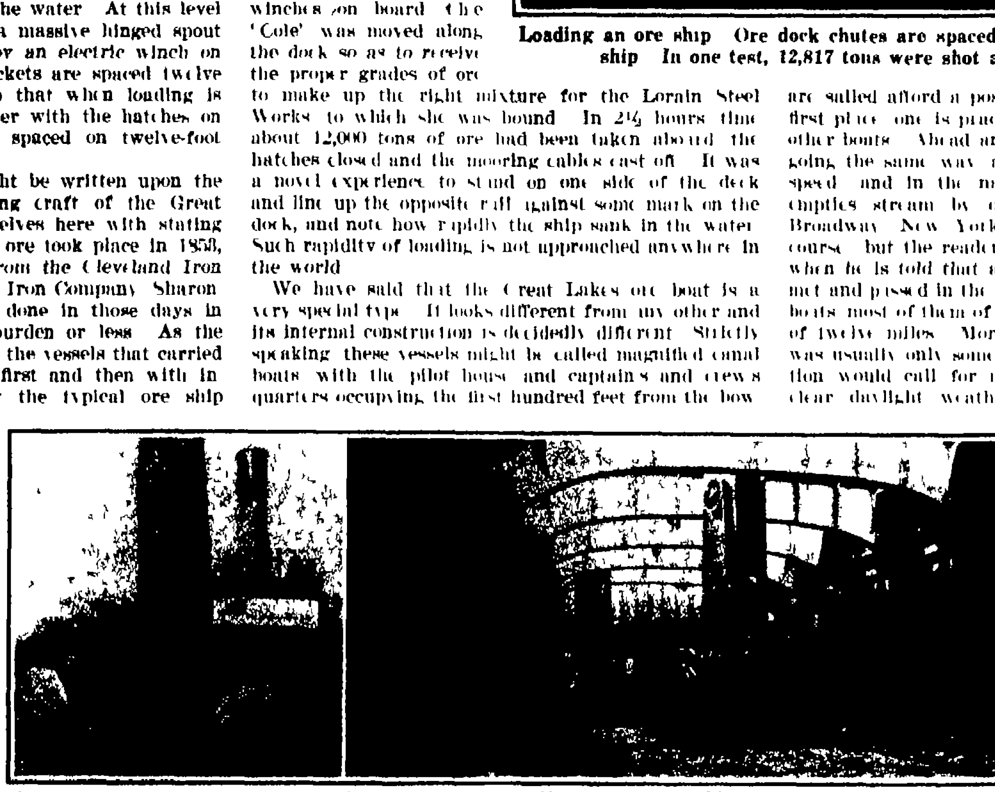


Three of the ore docks at Duluth. Length, 2304 feet. Max height, 84½ feet. Width, 60 feet. Combined capacity of ore pockets, 345,000 tons. The ore is loaded by chutes to the ship

has the problem of handling and transferring a huge tonnage, in a minimum of time and at a minimum of cost, been worked out to such perfection as is seen in the transportation of ore from Missabe to the far distant steel works. Thus, the unloading from car to ship is done entirely by gravity. To this end a series of huge ore docks provided with pockets has been built along the foreshore at Duluth. We show an airplane view of three docks of the Duluth, Missabe and Northern Railway, with the city of Duluth in the distance. Each dock is 2004 feet in length and the largest is 84 feet 5 inches in height from the water to the deck of the dock, and 60 feet in width. When the ore trains reach the bottom of the hill, they are moved out on to the ore dock and their contents dumped into the ore pockets. There are on this single dock 384 pockets with a total storage capacity of 153,600 tons. The dock is built of steel and concrete, and the bottom of the pockets is 40½ feet above the water. At this level each pocket is provided with a massive hinged spout which is raised and lowered by an electric winch on the floor of the dock. The pockets are spaced twelve feet from center to center, so that when loading is going on the spouts will register with the hatches on the ore ship, which are also spaced on twelve-foot centers.

Loading an ore ship. Ore dock chutes are spaced 12 feet, so are the hatches of ship. In one test, 12,817 tons were shot aboard in 16½ minutes

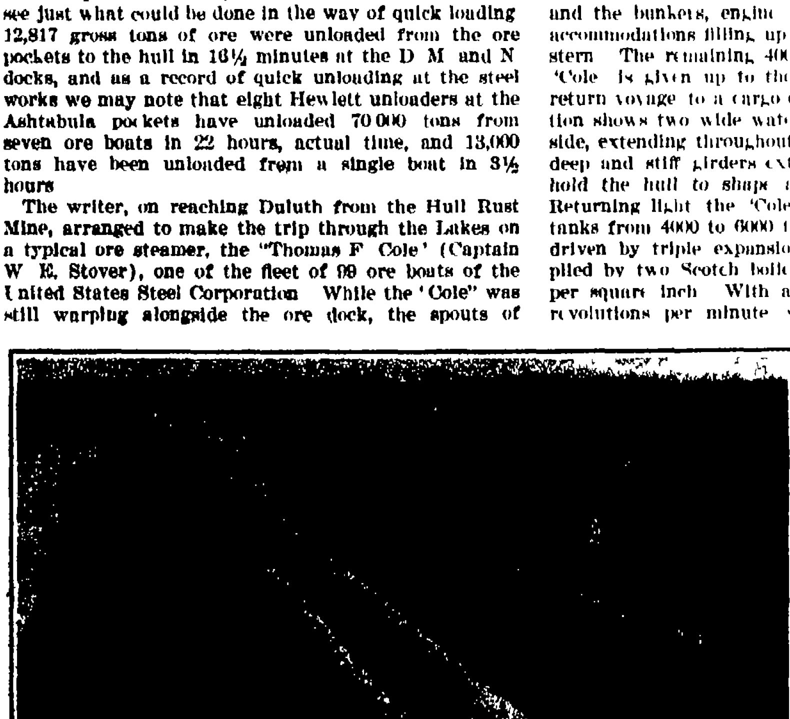
An entertaining chapter might be written upon the development of the ore-carrying craft of the Great Lakes. We must content ourselves here with stating that the first shipment of iron ore took place in 1858, when 152 tons were shipped from the Cleveland Iron Mining Company to the Sharon Iron Company, Sharon, Pa. Lake transportation was done in those days in little vessels of twenty tons burden or less. As the years passed the shipments and the vessels that carried them grew in size—slowly at first and then with increasing rapidity—until today the typical ore ship is a vessel over 600 feet in length, 60 feet in beam and capable of carrying from 10,000 to 14,000 tons of ore. These vessels have been developed purely along utilitarian lines. With their long, narrow shoal bodies, broken by deckhouses only at bow and stern they have none of the beauty of sheer and sweetly moulded lines which is found in an ocean going liner. But for their particular work of carrying a huge cargo at a fair speed, and of being loaded and unloaded rapidly, they are a positive triumph of human design. In a test of the steamship "D G Kerr," to see just what could be done in the way of quick loading 12,817 gross tons of ore were unloaded from the ore pockets to the hull in 16½ minutes at the D M and N docks, and as a record of quick unloading at the steel works we may note that eight Hewlett unloaders at the Ashtabula pockets have unloaded 70,000 tons from seven ore boats in 22 hours, actual time, and 13,000 tons have been unloaded from a single boat in 3½ hours.



Left. **Leg and open bucket descending through hatch. Note operator within the leg. Buckets of largest unloaders, when open, span 22 feet and pick up 17 tons.** ***Right*** **Cleaning up inside hold**

The writer, on reaching Duluth from the Hull Rust Mine, arranged to make the trip through the Lakes on a typical ore steamer, the "Thomas F Cole" (Captain W. E. Stover), one of the fleet of 99 ore boats of the United States Steel Corporation. While the "Cole" was still warping alongside the ore dock, the spouts of alternate coal pockets dropped down above the respective hatches of the ship the gates of the pockets were tripped, and 17 cataracts of ore began to stream down into the hull. Meanwhile two big streams of water ballast from 14 inch and 9-inch pumps were being discharged from the ship's side tanks. Care has to be taken to load the ship evenly and avoid any concentrated bending stresses. By means of wire cables and powerful winches on board the "Cole" was moved along the dock so as to receive the proper grades of ore to make up the right mixture for the Lorain Steel Works to which she was bound. In 2¼ hours time about 12,000 tons of ore had been taken aboard the hatches closed and the mooring cables cast off. It was a novel experience to stand on one side of the deck and line up the opposite rail against some mark on the dock, and note how rapidly the ship sank in the water. Such rapidity of loading is not approached anywhere in the world.

We have said that the Great Lakes ore boat is a very special type. It looks different from any other and its internal construction is decidedly different. Strictly speaking these vessels might be called magnified canal boats with the pilot house and captain's and crew's quarters occupying the first hundred feet from the bow and the bunkers, engine room and engine room crew accommodations filling up the last hundred feet at the stern. The remaining 400 feet of such a ship as the "Cole" is given up to the carrying of ore or on the return voyage to a cargo of coal. A midship cross section shows two wide water ballast tanks, one on each side, extending throughout the ship, and a series of 34 deep and stiff girders extending from side to side to hold the hull to shape and carry the hatch covers. Returning light the "Cole" will carry normally in the tanks from 4000 to 6000 tons of water ballast. She is driven by triple expansion engines, steam being supplied by two Scotch boilers at a pressure 170 pounds per square inch. With a horsepower of 2150 and 84 revolutions per minute she makes about 11.4 knots loaded. Her average load last year for ten trips was 12,180 tons of ore. The consumption of coal per day is only 48 tons. A truly remarkable performance considering the load and the speed.



A 12,000-ton ship in the "Soo" locks. Astern, in same lock, is another ship of 13,000 tons. In 1916, there passed through the six locks 91,888,190 gross tons, of which 64,734 tons was ore

The writer has voyaged in his time on all the seven seas and in every size of craft from a 150-ton coasting schooner to the "Leviathan" of 64,100 tons displacement, and he thought that he knew something about navigation and the ways of ships and the sea but that trip down the Great Lakes was a revelation. Not merely the ships but the way in which they are sailed afford a positively novel experience. In the first place one is practically never out of the sight of other boats. Ahead and astern will be other ore boats going the same way and generally at about the same speed and in the narrow waterways the returning empties stream by one almost like taxicabs down Broadway, New York. This is an exaggeration of course but the reader will understand what is meant when he is told that after leaving the Soo locks we met and passed in the channel no less than 24 big cargo boats most of them of 10,000 tons or more in a distance of twelve miles. Moreover at this point the channel was usually only some 300 feet in width. Such congestion would call for most careful navigation even in clear daylight weather but that particular twelve miles was navigated in the late afternoon, and when the dusk of twilight was deepened by the prevalence of heavy smoke from the autumn forest fires. Not soon will the writer forget the eight hours from late afternoon to after midnight that he spent in the pilot house. At the open window glass in hand stood the captain watching for those two white lights at the masthead of approaching ships to slow up through the murk and sounding at intervals the three warning blasts that are characteristic of Lake navigation. Presently out of the blackness would be seen the lofty masthead lights and then the red and green lights, of an approaching freighter. Speak of searoom! To our unpracticed eye it looked as though collision was surely inevitable. Then and not so many hundred yards distant the green light would be shut out. Presently there would loom up the black high bow of an empty ore boat and she would sweep by so closely that one could literally have tossed a biscuit aboard. How different from the transatlantic ship which as soon as she has dropped the Sandy Hook pilot, travels on a clearly defined easterly course and knows that the westbound ships are on their own course many miles to the north.

The open season for getting down the huge tonnage of ore on Lake Superior is only eight months in length. Hence all possible speed is made in the turn around at terminals and during the passage. When the captain takes his ship out for its first trip in the middle of April he knows that he is practically setting out on a voyage of 40,000 miles which lasts from the middle of April to the middle of December. There is practically no shore leave for him and his crew. Before he has completed tying up at the ore docks the ore is pouring into his ship. Before he has completed tying up at the steel works the huge unloaders are diving into his hold to bring the ore out. It is a strenuous life and the three months of rest during the winter are well earned both by captain crew and ship. Each vessel it need scarcely be said undergoes during the winter a very thorough overhaul and it has to be put into absolutely first-class condition. The few hours stay in port afford the engineer no opportunity to lift cylinder covers or make any major repairs. As we have said it is practically a continuous 40,000-mile voyage of eight months.

That excellent body of technical engineers known as the Corps of Engineers United States Army, have had

(*Continued on page 216*)

A Hydroelectric Giant

TWENTY FIVE years ago the SCIENTIFIC AMERICAN contained illustrations of a hydroelectric unit which because of its unprecedented size, was the wonder of its day in the electrical world. This was an electric generator driven by a water turbine of 5000 horsepower. It formed one of ten such units which filled the power station of the Niagara Falls Power Company who were the first to develop on a large scale a part of the potential powers of the Niagara Falls. Five years later in a comprehensive article on Niagara's developments we recorded the emplacement of 10 000-horsepower units in the plant of the Ontario Power Company and of 13,000-horsepower units in the plant of the Electrical Development Company both of these being on the Canadian side of the river.

In the two decades which have passed since then, there has been a steady growth in the size of hydroelectric units and during the last two or three years this growth has taken a spurt that has brought some truly astonishing machines as regards their size weight power and above all their economy. In California there are being installed 35 000 horsepower turbines for the Southern California Edison Company and 40 000-turbines for the Pacific Gas and Electric Company while, at Niagara, waterpower is being developed in the Canadian plant at Queenstown in five enormous machines of 55 000 horsepower each. The latest development is at the plant of the Niagara Falls Power Company on the American side of the river where the world's largest hydroelectric unit of 70 000 horsepower was placed in commercial operation in December by a delegation of hydraulic and electrical power men and government officials. This is the first of three such turbines with which this station will shortly be equipped.

The water for operating the new station is withdrawn from the Niagara River above the rapids. It is carried beneath the city of Niagara through a new hydraulic pressure tunnel, which measures 32 feet by 32 feet and is 4300 feet in length. The tunnel terminates at the edge of the high cliff on the American side below the falls. It is excavated through solid rock, and the material removed would fill a train of gondola cars reaching continuously from Buffalo across the State to Utica. The tunnel discharges into a large forebay, from which the water is led to the turbines in the power house at the foot of the cliff, by means of three 21 foot, slope-tunnel penstocks cut through the limestone cliff. After doing its work on the turbines, the water discharges into the Niagara River.

This giant unit weighs more than 1750 tons. It consists of a 70,000-horsepower, single runner vertical shaft hydraulic turbine attached to an electric generator delivering 52 000 kilowatts at 12 000 volts. When completed, the station will house units with a total rated capacity of 454 000 horsepower. The company has two other stations with rated capacities of more than 200,000 horsepower. The annual output of the American Niagara system alone is in excess of two billion, five hundred million kilowatt hours, and represents about one-third of the electricity sold in New York State.

The new hydroelectric unit uses 3200 cubic feet of water per second, with an efficiency of at least 93 per cent. It does not increase the company's diversion of water in any way, but does materially increase the efficiency of conversion into power. It uses the same amount of water formerly used by seven 5000 horsepower units and delivers energy equivalent to the output of 14 such units. Each of the three new 70 000-horsepower units will produce electricity which, if generated through the use of coal would require 700,000 tons annually. Although the new project will not use any more water than is now used it will so use the water as to produce an increase of 100 000 horsepower in the power output of the station.

The turbine of this unit is the highest power-capacity water-wheel ever built. It is a product of the I. P. Morris division of The Cramp Ship and Engine Building Company of Philadelphia. Specially designed cars were required to transport the great castings assembled into this turbine. The runner is a single-piece, steel casting, weighing 105,000 pounds. The turbine casing and control valve required 82 carloads of parts. The turbine converts the power of the falling water into mechanical energy, which is directly transmitted by means of a 32-inch shaft to the generator set immediately above.

The great generator sets a new high mark in design and construction of electrical equipment. The stator of the generator weighs 228 tons. The rotor, with its twenty eight 8-ton poles, measures 21 feet in diameter and weighs 190 tons. The revolving elements consist of rotor, shaft, and runner, the total weight being approximately 500 tons, and they are suspended from the top of the unit by a Kingsbury thrust bearing. The generator was manufactured at the Schenectady works of the General Electric Company.

The transmission lines radiating from Niagara Falls serve a vast community, stretching from Erie and Jamestown on the west to Syracuse and Oswego on the east. The flow of these veritable rivers of electricity will be substantially increased. East of the 147 communities in the 16 counties now served will enjoy more and improved service, and some two million people will share in the increased power produced by this project. However in spite of the additional energy from this new unit, as well as the energy to be produced by the other two big machines which go into service during the coming year, the demand for cheap, constant, Niagara hydroelectric power outruns the supply. New domestic and industrial uses of electricity are constantly developing and no further increase in output can be effected until present restrictions of the use of the waters of the Niagara River are modified.

Does Land Lie Near the Pole?

WHILE only about 35 per cent of the earth's surface has been subjected to civilization more than 90 per cent has been explored charted and ticketed for future human usage. Of the remaining 5 per cent the most mysterious and alluring part is without doubt the 1 000 000 square miles of unknown Polar Sea that lies directly northward from Alaska.

Next June or July Amundsen's three planes will fly from the old Zeppelin trans-polar base in Spitzbergen directly across this unexplored area. One of these planes will be in charge of Lieutenant Davidson U. S. N. The Navy Department has officially announced plans for a prospective flight of the new navy dirigible, the "Shenandoah" across the top of the world.

The chances that land will be found by these fliers are about five to one. Even if there be no actual polar continent there is still every prospect of polar land. Vast ocean spaces are not infrequently dotted with broad topped fertile islands jutting from their depths and having no connection with any continental mass. The single feature in common among such islands is their situation on or near a line of volcanic activity. This fact contributes one of the solidest reasons for believing new land lies near the North Pole.

Japanese Aleutian lines of the subterranean activity point poleward. Down the other side lie Spitzbergen and Iceland. The latter is one of the most intensely volcanic spots on the globe. So it is reasonable to conclude that somewhere between Iceland and Alaska in the Arctic Ocean may lie a similar nubble of land upthrust through the polar pack.

Even more substantial evidence of a polar land issues from the results of northern data worked up by the tidal expert Dr. R. A. Harris of the United States Coast and Geodetic Survey. He fitted together such bits of evidence as the drifts of the Fram and the Jeanette observations of movements of the pack ice rise and fall of tide in Greenland and Alaska and so on and he concluded that there must be a large body of land or shallow water as yet undiscovered in the polar regions."

Supplementing theoretical deductions are several reports of whalers and northern travelers who claim they actually sighted land. Chief among these is Admiral Peary's experience in 1906 when he went westward along the shore of Grant Land on which the "Roosevelt" was wintering and saw distinctly the snow-clad summits of the distant land in the northwest above the ice horizon. And whalers off the coast of Alaska penetrating in open seasons to high latitudes, a dozen times declare that they have sighted the shores of new land looming through the arctic murk.

A new Polar island or continent will likely be in some respects radically different from other lands bordering on the northern sea. In the first place its volcanic origin would make for a more rugged terrain than the low barrens and tundra of North America or the flattened steppes of Siberia. In view of the considerable interval between known lands and the new land its meteorological features would probably be different. There would be enough less precipitation to prevent the formation of large glaciers such as are found along Alaskan and Greenland coasts. Without such flowing water there should be relatively less weathering than further south. The work of frost would be the chief agent of rock disintegration.

It is unlikely that any new species of animal or vegetable life would be found upon it. But we might expect nearly anything in the way of mineral resources. Coal unquestionably for coal is being found in the Arctic in ever increasing quantities. If the new land is anything like Alaska it will be a find indeed.

The new land would by no means lie beyond the line of human habitability. Spitzbergen's coal mines which have been profitably worked, are in almost exactly the latitude of the center of the unexplored region north of Barrow.

But before we could lay claim to all these riches we must land and take possession. That is a more serious matter than it seems at first sight. In the first place the Polar pack is a vast disk of rough and nubbled ice some 2000 miles in diameter. This disk is constantly surging back and forth under the influence of tides and winds. Where it collides with any land mass it is torn and shattered by the impact. Thus along its fringes the polar pack possesses a band of "pressure ice from 20 to 50 miles in width. For a plane or dirigible to land in this area of wreckage would be suicide. The one real chance for setting foot on the new land would lie in the fact that when wind and tide break leads in the heavy pack these leads are open water until the wind or tide changes again. For a brief period they afford proper landing area for a seaplane.

It has been suggested that the land be first located from the air and then explored by Peary sledge methods from a base at Point Barrow. On the final North Pole dash from Cape Columbia on the northern coast of Ellsemere Land Peary's goal was about 500 miles from his point of departure. But Barrow is 1117 miles from the Pole twice Cape Columbia's distance. Movements of the ice-pack thereabouts are more eccentric than in any other part of the Arctic. One may go to bed with a solid jam right on the beach and wake up with no ice in sight open water clear to the northern horizon. Such movement would be disconcerting to a sledge expedition to say the least.

Before the problem of accessibility of the new land has been solved a party might be established there from planes, having taken chances on smashing their machines. With kites or captive balloons radio aerials could be raised and communication attempted with the southern base. The weak point in this plan is that MacMillan's outfit at Etah and Amundsen's vessel, the "Maud," drifting north of Siberia have both demonstrated the presence of a mysterious radio barrier that exists in high latitudes during the summer months. Whether this is a direct corollary of the constant daylight or a result of the excess static existing over the Polar Basin cannot yet be said.

Even after reaching and occupying the new land the question of creating an unassailable claim to it is by no means a simple one. By international law territory must be inhabited in some degree of permanency before it can actually belong to the claimant power. There are islands in the Pacific which American mariners have visited and developed over which we cannot hoist our flag because we have not fulfilled the tenets of the law.

One solution would be to transfer our Eskimos from Alaska there. Eskimos are ethnologically one of the most distinct branches of the human race. Their peace-loving responsive natures have let them in for all the ills and evils of civilization. Isolated in an environment to which they are suited they lead happy and efficient lives.

There would be no cruelty attached to such a social experiment. The Smith Sound tribe living on the northwest coast of Greenland are now the most northerly and isolated people in the world. They are healthy and carefree. They are hospitable, proud, capable men and women. They have no desire to go south where dwells the eccentric white man. The latitude of their upper village at Annorotok is nearly that in which inhabitants of the new land would live.

The new colony could not be exploited. Governmental control of its visitors would prevent the poisonous effect of unrestrained civilization from getting in its evil work. Yet development of natural resources or simply the preparation of the place for future scientific investigations could go on.

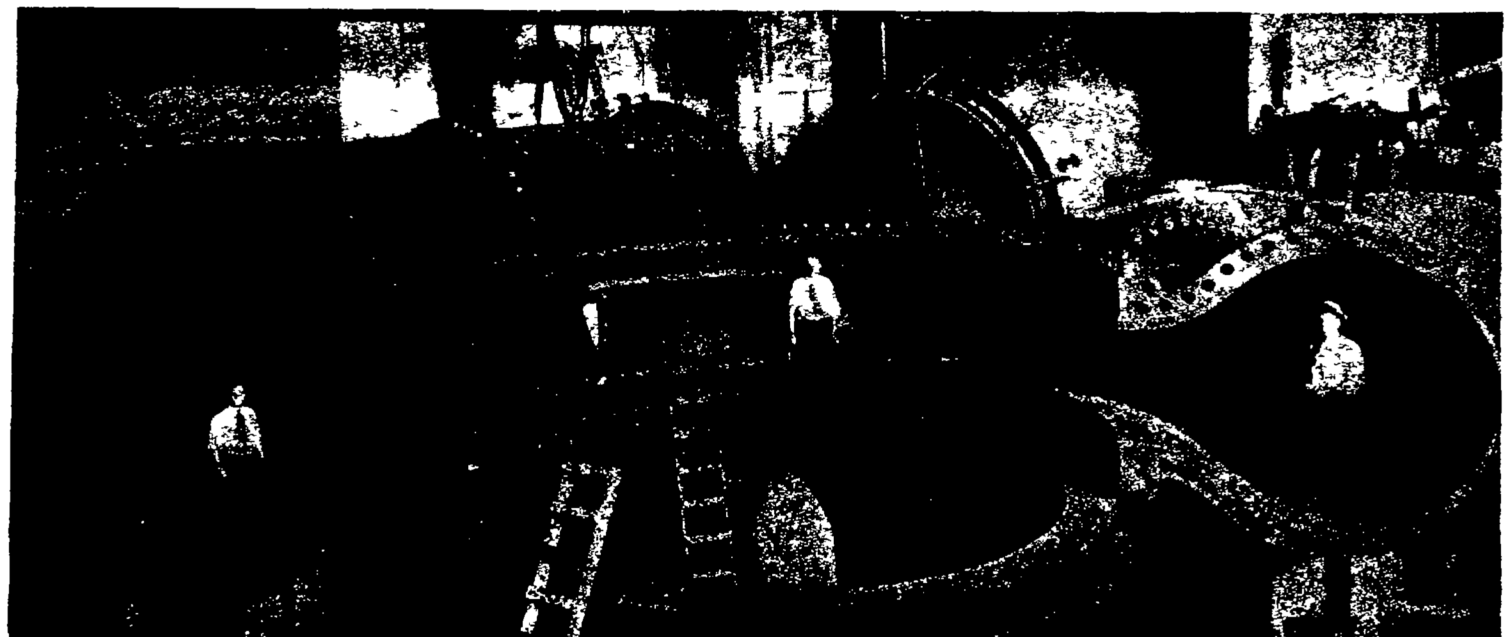
Altogether the chances that new land may be found are good enough to warrant serious search for it. Its conceivable resources and uses augment the urge to open up the great blank space above Alaska. Finally, there is always the vivid fascination involved that the unknown has held for men since the beginning of time.

The 70,000 horsepower generator Within the cylindrical casing are the stator and the rotor, and below the floor is the water wheel or runner The heavy steel brackets above the casing hold a Kingsbury bearing, which carries the combined 500-ton load of the rotor and runner which are suspended below it

The huge stator or field of the generator This generator establishes a high water mark in the design and construction of electrical equipment The stator alone weighs 228 tons. The two men shown standing within it give an instant impression of the great dimensions of this whole outfit

This view shows the 400 ton rotor with its twenty eight poles, each weighing eight tons, being lowered into the stator The rotor is coupled to the 32 inch dia. suspended vertical shaft of the water-wheel, which is hung below the floor of the generator room

The water-wheel, a single steel casting, weighs 52½ tons. The water rushing through the wheel develops 70,000 horsepower before it is discharged into the tailrace below This power is transmitted to the generator rotor by the 32-inch diameter shaft above the wheel



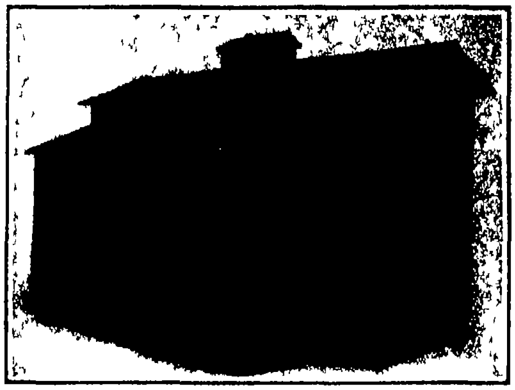
This remarkable view shows where the water, at the rate of 3200 feet per second, is received and distributed around the periphery of the runner In the upper right center is the inflow tube, with its conical valve for regulating the supply The water rushes around the great circular tube and is directed into the runner by fixed guide vanes on the inner side of the tube. The tube decreases in diameter proportionately to the amount of water that flows from it to the runner After it has done its work on the wheel, the water discharges through the circular tube in the foreground. The water for operating this gigantic hydroelectric unit comes from the Niagara River through a new hydraulic tunnel, a distance of 4300 feet, and more directly from a large forebay and a slope-tunnel penstock cut through a limestone cliff From the turbine, the water discharges into the Niagara River

SOME DETAILS OF THE NEW 70,000-HORSEPOWER, WATER-DRIVEN GENERATOR AT NIAGARA—(See facing page for description)

When a Second Seems an Age

Filming Rapidly Moving Objects by Means of the Heape and Gryll Rapid Cinema Machine

By P. J Risdon



This light tight housing contains the high-speed motion picture camera

IT MAY be said that the object of the ordinary cinema is served when pictures taken of still or of moving objects are reproduced on a screen at such a speed that the eye cannot detect any departure from normal continuity of motion

But then we come to another aspect namely that of photographing bodies in such rapid motion that the eye cannot follow the individual movements, but can only take in the motion as a whole A galloping horse and most natural animal movements come under this category In such cases if it be desired to analyze the movements pictures taken need to be projected at a slower speed

In the next place there are rapid movements such as those of bullets in flight falling bodies and so on requiring still higher speed photography and slower speeds of projection to permit of the movements being followed by the eye at all Take the case of photographing a bullet from a machine gun firing 1000 shots a minute a complete cycle is over in one-sixteenth of a second during which time a complete set of pictures must be taken Some very fine results have been secured in this direction showing just what occurs for instance when a bullet strikes a glass globe

Science, however, could not long remain satisfied with such results and the Heape and Grylls Rapid Cinema Machine is the latest forward step in high speed photography As in the case of many other important inventions its design construction and operation are based upon perfectly simple and familiar principles Yet a complete film comprising 288 photographs, all taken in less than one-sixteenth of a second—at the rate of 5000 pictures a second—is the proved performance of this machine Not only so, but the pictures can be taken in pairs if desired so as to produce a stereoscopic effect—a point of very great importance—or a second film of 288 pictures may be taken following directly upon and in fact overlapping the first

The machine which is of English conception and execution comprises a large steel film drum about 68 inches in diameter mounted on a shaft directly coupled to an electric motor the speed of which is variable from 100 to 1000 revolutions per minute These speeds correspond to from 500 to 5000 photographs per second The shaft is mounted in bearings carried on steel girders resting upon cast iron foundation blocks

On each side of the drum and bolted to it is a circular rack that engages a bevel pinion on a horizontal shaft on the front end of which is fitted a lens wheel

Normally the outer edge of the drum is cased in to exclude the light, but there is a hinged section of the casing that can be opened for inspection purposes, and for winding on the films.

The drum is wide enough to take two films spaced several inches apart in grooves on the rim Standard films are employed so that any film taken may be used in an ordinary projector The two films which are unperforated are wound on the drum side by side, each making up a single turn on the drum circumference, sufficient for 288 photographs the two ends being cemented together where they overlap In order to maintain them in close contact with the drum air is exhausted from beneath each film so as to obtain a degree of vacuum equivalent to 12½ pounds per square inch below atmospheric pressure The air is exhausted through a hollow in the drum shaft by means of a vacuum pump

The drum, which weighs 1000 pounds and has a maximum peripheral speed of 18,000 feet a minute, is stressed to five tons per square inch at the rim at this speed

In each of the lens wheels already referred to, 40 lenses are mounted in such a manner that, as the wheel rotates, each lens in succession throws an image on to its respective section of film, the pitch or spacing of the lenses corresponding exactly to the standard pitch of the pictures namely ¾ inch The bevel gearing is in such a ratio that the lenses pass the apertures through which the exposures are made, at exactly the same rate as the film The lenses which have an aperture of F/4, are focussed by setting the wheels on the shafts by means of screw thread adjustments to index marks corresponding to the known distance of the object The maximum speed of side shafts is 120 revs per second.

Huge motion-picture camera for taking ultra-speed "movies," with its mirror at the right The mirror serves to reflect images in photographing shell explosions, thus protecting the camera

An extremely important feature is the shutter mechanism and control The shutter mechanism comprises a vertical metal falling plate that works between roller guides mounted on a fixed casting This vertical plate and the upper portion of the casting are arranged so that they lie between the films on the drum and the lens wheels In the fixed casting there is a pair of focal plane slits, opposite which the two sets of lenses pass The narrowest focal plane slit is about one-twenty-eighth of an inch The lower portion of the casting forms a box in which three spring-controlled electromagnets are housed

On the upper portion of the falling plate is mounted a disk with two apertures in it These apertures are crossed by each of the revolving lenses in the corresponding lens wheel By means of a simple adjustment these apertures may be arranged side by side when stereoscopic pictures are required, or may be staggered so that only one slit is uncovered at a time if two films are to be exposed in succession

The shutter is suspended from a bracket on the drum casing by a vertical rod, and when it drops its fall is accelerated by strong springs The first movement of the shutter is controlled by the three electromagnets above referred to which depend for their action upon an interruption in their electric circuits.

In the case of photographing a shell striking an armor plate, the ***modus operandi*** of the photographing process is as follows

A wire, which completes the electric circuit in which the electromagnets are placed, is stretched across the path of the projectile, at a distance from the target that suits the time lag in the shutter mechanism and the speed of the projectile The distance is usually about 30 yards The shutter having been set according to speed and whether stereoscopic pairs or single photographs are to be taken and the machine having been started and run up to the required speed when all is in readiness the gun is fired, and the projectile, on its way to the target, severs the wires in its path, thereby breaking the electric circuit and allowing the shutter to fall and admit light to the revolving lenses through the focal slits, at the moment that the shell strikes the armor plate In the following one-sixteenth of a second, 288 photographs are taken

A little consideration will show that, for taking photographs at the rate of 5000 a second, ordinary daylight would not suffice. With a film speed of 18,000 feet a minute and a focal-plane slit of one-twenty-eighth of an inch the time during which any portion of the film is under exposure is only a hundred thousandth of a second. Special methods of lighting have, therefore, to be resorted to In the case of a small object not occupying more than a fifteen inch diameter circle, the beams of any two powerful 120-ampere searchlights with three-foot mirrors concentrated upon it give sufficient light But in order to illuminate a large object such as an armor plate sufficiently, magnesium or aluminum is employed

The machine, which without auxiliary apparatus, weighs four tons is contained in a double walled light tight house, to which access is obtained through an antechamber with double doors, so that the operator may enter or leave without fear of admitting light and fogging the films. Inside the house, a non actinic, red lamp, lighted from electric accumulators is provided to facilitate changing the films on the drum for which purpose special mechanism is included for winding the films on the drum from spools, and unwinding them again

In photographing at close quarters the action of an armor piercing shell upon an armor plate, the question arises of how to protect the operator and the cinema machine itself from injury from flying splinters—indeed, possibly from destruction The problem has been solved by arrangements which place the operator in a position of safety and enable the machine to be adequately protected.

By the use of connecting cables, all the controlling apparatus together with the electric generator may be placed 500 yards from the cinema machine so that it is unnecessary for the operator to be within the zone of danger of an explosion, although he can exercise just the same control as though he were on the spot

Front view of the ultra-speed camera, showing one lens wheel in position and the other removed

New Ways to Use Slate

HITHERTO, from 80 to 95 per cent of the gross production of all slate quarries in the United States has been discarded as waste. The losses involved in handling so much waste and the consequent added cost of the finished product have resulted in the U S Bureau of Mines devoting considerable scientific study and investigation to the problems of reducing the proportion of waste and of utilizing the unavoidable waste This government agency was not equipped for conducting detailed researches with waste slate-dust so it enlisted the scientific services of the various commercial projects and plants interested in the conservation of slate and these concerns have performed the actual tests under the supervision of the Federal authorities

The results of these experiments show that pulverized slate, or slate flour may be used satisfactorily as a filler to give body and to supply the necessary wearing qualities to rubber articles of everyday use such as garden hose, rubber shoe heels and soles, carriage tires, and rubber packing and disks of different kinds It has also been determined that ground slate may be used to advantage as a constituent of some classes of linoleum, oil-cloth and window shades The early tests indicate that with finer grinding, this by product material may prove an efficient filler for the manufacture of automobile tires, phonograph records and other products requiring extremely fine-grained filler

For plastic roofing and flooring products containing coal tar, powdered slate has long been used and constitutes a most satisfactory filler The insoluble character of the slate renders it of special value for acid proof plastic flooring and as lining for acid tanks Approximately 75 per cent of the volume of certain types of plastic flooring is composed of ground slate and according to government reports, several hundred carloads of waste slate are annually used for this purpose Although pulverized slate will have to compete with established articles which have long been used in the various trades and industries, nevertheless, slate flour is sure to rise rapidly in popularity because in addition to being eminently satisfactory and serviceable, it is considerably cheaper than some of the filler materials such as talc, soapstone foreign and domestic china clays, pulverized limestone or marble aluminum flake, whiting, ochre or mineral paint

The manufacture of filler for road asphalt mixtures is another promising field for slate waste utilization according to the investigations of the Bureau of Mines In the ordinary preparation of asphaltic mixtures for surfacing roads, finely pulverized limestone or portland cement are used as fillers in addition to the sand or stone and sand aggregates. In asphaltic mixtures, in which by product asphalt is used, the weights of filler and asphalt are substantially the same, but when certain types of native asphalts are used, a somewhat smaller proportion of filler is required. The amount of such filler annually used in asphalt mixtures is very large, the city of New York alone using more than 50,000 tons a year Government tests have shown that slate flour is admirably adapted for use as a filler in such asphaltic mixtures and accordingly, it is expected that a considerable amount of waste slate will be devoted to national and state road construction purposes.

Dining Car Profits

WE are apt to complain, when we travel, of profiteering in the dining car The Pennsylvania Railroad has answered this by a neat little pamphlet in which it shows that the average cost per meal is $1.3831 and the receipts average $1 1682, leaving a loss of $.2149 per meal, or $175,228 annually Some of the figures of supplies are amazing In 1922 there were required 427,378 pounds of ribs of beef, 321,888 pounds of loins of beef 174 802 pounds of lamb racks 380 498 pounds of chickens etc Vegetables, fish butter eggs etc as well as bakery products hold the same large proportions

The machining of molybdenum steel rolls

Molybdenum and Its Applications

AS long ago as 1911 it was recognized that steels alloyed with molybdenum possessed valuable characteristics but this fact could not be commercialized at the time because the known supplies of molybdenum ore were too small and of too low grade But extensive prospecting during the war brought to light deposits at Climax Colo, and Questa N M, which put the United States in the position of having a greater supply of this metal than the rest of the world combined The result has been that today the molybdenum industry is one of the most important branches of American metallurgy

It is too much to say that the radio development of today has been made possible by any single contributing factor It is however undoubtedly true that molybdenum's availability in commercial quantities has been of as much aid in this development as any other single item For this is the metal employed in making the grid in that all-essential part in both sending and receiving outfits the vacuum tube No other metal gives the same satisfaction here

But the principal use of molybdenum is in the manufacture of special steels Wherever it is desired to combine great toughness great strength and great resiliency with its corollary of ability to withstand the 'fatigue of repeated stress, there is an opening for molybdenum steel This alloy is easy to fabricate and to subject to heat treatment, and is cheap to manufacture

One of the most trying uses to which metal is put is in the springs of taxicabs. It has been found that the average life of these members is from four to six weeks Experiment with molybdenum steel in Pittsburgh is said to have tripled the life of these much abused members Again railroad workmen insist upon using their steel shovels for prying out spikes and nails It has been demonstrated that a molybdenum steel blade will stand up under this sort of thing far longer than one of more ordinary metal

Another interesting application of molybdenum steel is in cold-cutting tools. Here are required great hardness and extreme toughness—qualities which contradict themselves in ordinary steel which becomes more brittle as it is made harder But molybdenum steel has the hardness and the toughness, and high elasticity in the bargain

Various automobile parts—axles propeller shafts gears, etc—as well as motor trucks tractors heavy machines of all sorts—punchers headers reamers and other hot and cold working tools, dies and die blocks are all made to advantage from molybdenum steel by rolling or forging processes of one sort or another

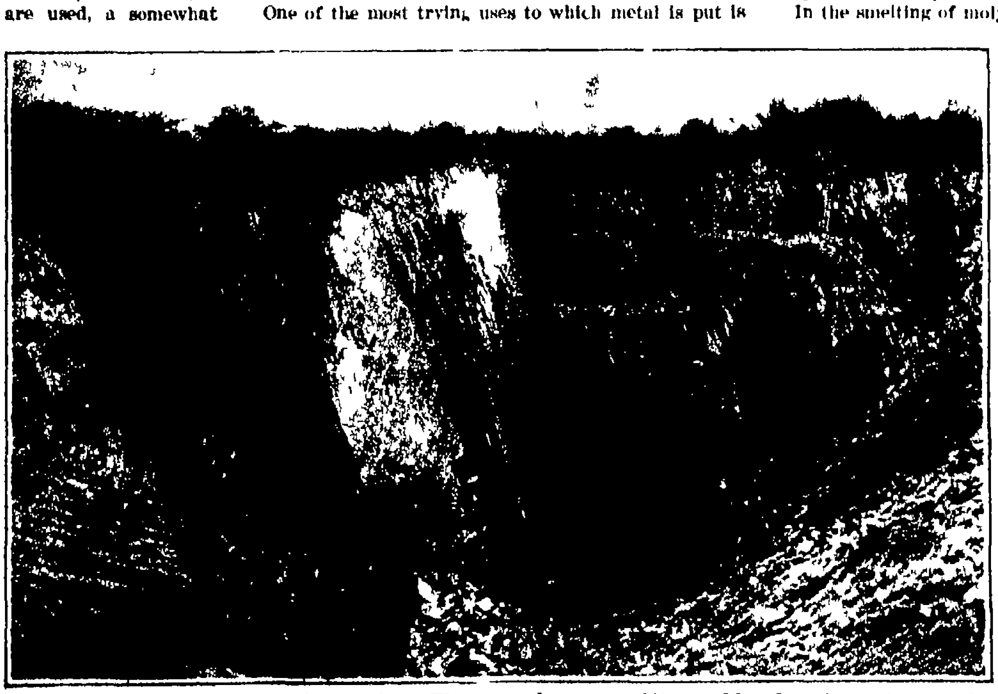
There are similarly important uses for molybdenum in the manufacture of cast steel parts of machines, etc. For example the life of the average crane wheel is about six months By making this part of the crane from molybdenum steel its life can be increased two to four fold At the present time there is a cast chrome-molybdenum steel crane wheel in service for over two years without being re-machined In fact the metal is worn away on the bearing surface of this wheel for a depth of only one-sixteenth of an inch

Locomotive frames large castings for ships cars, etc have been made from molybdenum steel resulting in a material increase in the strength of the different parts The resistance to sudden shock is thereby augmented by at least 50 per cent

The I beams channels, plates angle-irons etc used in steel building construction rails etc are made by rolling the hot metals between steel rolls The wear and tear on these rolls is very great indeed In the accompanying cut there is shown a molybdenum steel roll in the course of actual machining Attention is called to the large size of the cuttings which is a very good indication of the toughness of the steel Ordinarily a steel of similar hardness will not machine so well at all for the cuttings or shavings will be almost as fine as dust indicating that while the steel is hard it is not very tough and elastic A test of molybdenum steel rolls made recently yielded the unequalled production of 625 000 tons of steel before the rolls required repair In the manufacture of these steel rolls the fact that the heat treatment of the molybdenum steel rolls is carried out with considerable ease is a factor of paramount importance

In the smelting of molybdenite which is the principal molybdenum ore there are produced concentrates, which are roasted and treated with acid to produce a variety of molybdenum chemicals, which are of considerable technical and industrial importance For example molybdic acid, phosphomolybdic acid, sodium molybdate and other salts are formed, which are used for various purposes in the dye industry in medicine and pharmaceutical preparations, and quite extensively in the analytical chemical laboratory

The molybdic acid may be mixed with charcoal and heated in an atmosphere of hydrogen to produce pure molybdenum powder This may be compressed into billets and swages rolled or die drawn into sheet and wire These products are then used as mentioned above in vacuum tube manufacture. The powder is also used as a blue pigment in making fine grades of potteries and porcelains.



A slate quarry in Piscataquis County, Me The waste due to crumbling and breaking in getting out the slate has been running between 80 and 95 per cent for the entire industry

More Steam-Engine Power Without Steam

Replacing Water and Steam with a Mysterious Liquid and Its Power-Producing Vapor

By Ismar Ginsberg
Chemical Editor, Scientific American

SINCE Watt first conceived the idea of steam as a power producing medium there has been little done to replace steam by any other fluid which would give more efficient results. True, there has been the mercury engine development but this is not as yet thoroughly tried out in the commercial sense. That the engineers should have kept to steam for so many years is not all strange for water is plentiful and despite the disadvantages occasioned by the use of certain kinds of water which cause the formation of scale on the internal walls of the boiler and boiler tubes there are many counteracting advantages connected with its use. Every effort has been made to develop a greater degree of efficiency with steam by the use of superheaters, feed water heaters, condensing engines, etc. but the most that has been accomplished is very small compared to what is claimed to be obtained by the replacement of water by a new fluid.

It is understandable that every liquid that will develop a vapor may under suitable conditions be used to develop power in a cylinder. Water is by no means the only substance that will do so. In a certain series of experiments that were made with a view to securing a liquid for use in an automatic fire extinguisher which liquid would respond quickly to a rise in temperature and rapidly evolve a vapor whose pressure would release the valve closing the extinguisher and throw its contents into the air of the room where a fire had developed fortuitous circumstances led to the finding of a liquid which was being made for other purposes but which possessed these properties in a marked degree.

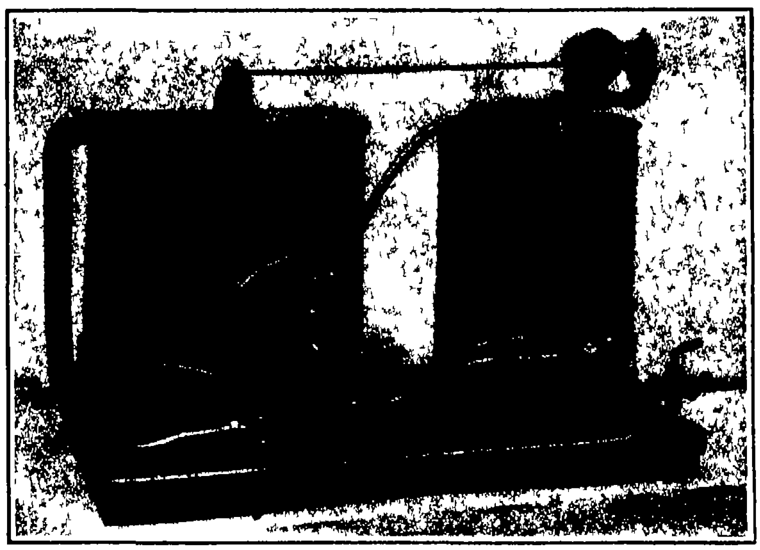
The new power generating fluid is really a very remarkable substance and actually generates power with an efficiency that far exceeds that of steam. The writer witnessed several experiments made in Philadelphia *on experimental engines driven by the new liquid* which proved to his entire satisfaction the various claims made for it by the inventor.

Before describing these tests it may be advisable to say a few words about the liquid itself. It is a water like mobile fluid with a rather sweetish odor and a very low boiling point. It rapidly evaporates in the air and chills the hand just like ether or other volatile substances. But while it is extremely volatile, unlike ether it is absolutely non inflammable and non explosive. A test was made with the substance by trying to ignite it with a burning match. Not only was the match extinguished by the liquid itself but a second test showed conclusively that the vapors of the liquid are likewise non inflammable. The liquid is also non corrosive. The experimental engines and the various other parts of the apparatus made from copper brass iron or steel showed no signs of any corrosion either from the liquid or its vapors. In the boiler in which the liquid was heated to convert it into a vapor there was no deposit. It was said that the boiler had been in use for a considerable length of time at any rate for a sufficient length of time for a deposit to have formed.

Perhaps the most remarkable property of the liquid is the ease with which it develops vapor under pressure. The Bureau of Standards has made an investigation of its boiling point and the pressure of the vapor at different temperatures. It is interesting to note that at 212 degrees Fahrenheit at which point steam has no pressure at all the vapor of this liquid showed a pressure of 85 pounds per square inch. At a temperature of 422 degrees Fahrenheit at which point steam has a pressure of 300 pounds per square inch the new power medium has a pressure of 1000 pounds per square inch.

This is the reason why it is possible to generate considerably more power with the new vapor than with steam, and at the same time effect considerable economy in the consumption of heat. Other physical properties of the new liquid which are of interest are its low specific heat and latent heat of vaporization.

It is evident that the same amount of heat will produce more vapor at a higher pressure and within a shorter period of time when applied to the new liquid, in comparison with water. In other words the new vapor contains less heat than steam under similar conditions of temperature and pressure. This might lead to the conclusion that it would be impossible to produce power with the new vapor in a reciprocating engine or turbine because the vapor would condense on expansion forming a liquid and generating no power. It was similarly argued that it would accordingly be necessary to keep the engine or turbine at an elevated temperature to prevent this from happening so that the heat saved in the first instance would have to be used in this manner thus wiping out any real saving in heat.



Model turbine with condenser, arranged for operation with the mysterious power producing liquid which takes the place of water

But this does not happen. Demonstrations made in the presence of the writer proved *without a question of doubt* that the vapor of this liquid will run an engine or turbine. Just to prove the efficacy of the vapor, a small copper cylinder was filled with a little of the liquid, the cap was screwed on tight and the outlet was connected to the steam cylinder of a small toy, reciprocating engine. The copper cylinder was then held under a stream of hot water running from a faucet. The engine worked splendidly running at a high rate of speed.

A number of tests were made with a model turbine installation, shown in our first view. This is a closed system, it being a fundamental idea of the new power generating system to operate in this fashion. To the right is seen a copper boiler which is made with vertical tubes so as to secure maximum heating results from the gas burner seen at the extreme right. In the center foreground there is seen a small turbine, which is fed with vapor from the boiler by the upper pipe line, furnished with a valve at one end and a pressure gage at the other. The exhaust from the turbine goes into the water condenser, which is located back of the turbine, and the condensed liquid runs into the small well, seen to the left of the turbine, from which it is pumped back again into the boiler by means of a small pump connected to the shaft of the turbine, located immediately in front of it and run by it.

One gallon of the liquid was filled into the boiler and the heat was turned on. Within a period of six minutes the pressure gage indicated a pressure of 100 pounds per square inch. The valve on the turbine feed line was then opened and the turbine immediately started operating. It eventually reached a speed of 8000 revolutions per minute. This test was to demonstrate the fact that the new liquid will generate a vapor which will run a turbine in a closed system so that no additional liquid need be added to the same during its operation. The apparatus worked perfectly. The vapors were easily condensed and the condensed liquor was pumped back into the boiler. There did not seem to be any difficulty experienced in the running of the apparatus.

The next test was for the purpose of demonstrating the superiority of the new power medium over steam. The apparatus used is shown in our second view. The arrangement is very simple. It consists of two boilers built identically alike with the same dimensions, and connected by a small pipe to a small reciprocating engine. The pipe is controlled by a three-way valve, so that the vapors from either of the boilers may be passed through the engine.

Model steam engine and two boilers, one using the new liquid and the other the usual water, so that either the new vapor or the steam power can be applied to the engine

The test was first made with water, both boilers being filled to the same level with the two liquids water in the left boiler and the new liquid in the one on the right. The heat was supplied by the gas burner seen in the figures. It took sixteen minutes for the water to be heated up to such a point that the gage registered a pressure of twenty pounds per square inch. The three-way valve was then opened and the steam was allowed to flow into the steam cylinder of the engine which immediately started running. It was run for about ten minutes or more to allow it a chance to develop maximum power and then weights were added to the brake beam that is seen in the figure. The ratio of lever arms on the brake beam was four to one, so that the actual force exerted on the flywheel shaft was four times the weight on the pan of the beam. The steam pressure dropped almost immediately to zero after the engine started operating and remained there during the experiment. Weights were then added to the pan and when three of them, all equal in weight, had been placed on it, the engine stopped running.

The boiler on the right was then heated with the same burner the flow of gas through it being maintained absolutely constant. It took exactly two and

(Continued on page 216)

Highest camera stand ever built perched on top of a 90-foot steel boom and used by cameramen and director during the filming of the Feast of Bagdad Note the sunshades overhead and the two platforms one above the other This type of platform permits of shooting scenes from any height and any angle within the limitations

The film story called for an idol of such size that it was impossible to construct it on the studio lot In spite of this however it was imperative that the idol be shown in the picture The technical department did the impossible by building the idol in sections as shown in this view each section being photographed separately and then assembled on the film This ingenious bit of trick photography was accomplished by using a series of mats to cover certain portions of the film while others were recording a section of the idol and involved that remarkable precision of modern cinematography

The make-believe City of Bagdad about the year 800 A D Experimental work with models convinced the producers that the surfaces used in the Bagdadian scenes of this photoplay should be plain simple and massive Most of the building walls were constructed of plaster with a ribbed or corduroy finish calculated to diffuse the crystalline brilliance of sunlight concentrated on it by huge tin reflectors, in a manner which would give a textile sheen The finish was painted in varying tones of gray silver and in several instances, dun color The shade deepened gradually as it ascended thereby taking the weight of the buildings off the ground and suspending it in the clouds, artistically speaking A glistening glossy black was chosen for the floors because it reflects the exact color of light thrown upon it Here again we see the novel camera-stand which saved much time and trouble in filming the action

Douglas Fairbanks sends his magic rope into action The Thief of Bagdad contains a taste of the modernistic and impressionistic schools which must prove a delightful surprise

MAKING THE PHOTOPLAY UNREAL: HOW SCIENCE AND ART HAVE PRODUCED A SCREEN FANTASY

The Gelatine You Eat

How the Pure Food Laws Restrict the Raw Materials of which It Is Made

By A G Ingalls

GELATINE that exquisite confection that melts away in the mouth into cool fragrant nothingness is assimilated by the stomach quicker and with less effort than any known food Hospital physicians as well as hospital patients are so well aware of this fact that it finds a large place in the diet of the sick That those who are well love it almost goes without saying When the appetite palls and we seem to crave nothing at all gelatine by some magic slips down the throat and leaves a sense of fullness without a sense of qualm In food value it is almost equal to sugar and like it it supplies heat and energy to the body without burdening the digestion with proteins Gelatine is not only a welcome dessert but it is food

The quaint old Dutch city of Delft noted for rare porcelains is also noted for its manufactures of gelatine To its quays come tramp ships laden with cargoes of bones from India while other ships carry to the United States large consignments of gelatine that has been made from these bones More gelatine is used by the United States than all the rest of the world put together for we are the greatest consumers of ice cream in the world and it is a fact that over 90 per cent of the commercial ice cream made in this country contains gelatine The next time you eat ice cream remember that one of its important constituents probably came from India and was derived from animal bones

Bones from India? Bones of what? Not old bones bought of the rag-pickers! No Gelatine of the kind that is made in the Netherlands is made from the carefully selected shin bones of the East Indian water buffalo This is not the buffalo that once roamed the Great American Desert in seemingly inexhaustible numbers It is not even a wild animal In India the water buffalo takes the place of the horse It is the principal farm animal It is domesticated But the Hindu does not eat water buffalo—any more than he eats beef Buddhism forbids either the eating or the killing of all animals and it is because of this religious taboo that ninety thousand tons of sun bleached and degreased buffalo bones are available annually for the manufacture of gelatine, as well as of bone buttons and Japanese ivory carvings

Gelatine is found in the bones of most animals, as well as in certain of their tissues and membranes, and its easy availability derives from the fortunate fact that while insoluble in cold water, it is easily soluble in hot When cooled it forms a jelly which is able to include within its mass from five to ten times its own weight in water

In a chemical sense ignoring the highly important considerations of freedom from harmful bacteria and certain chemicals introduced in manufacture, common glue is not greatly different from gelatine However little pains need be taken to insure that glue should be germ free Its essential quality is its stickiness As long as it is sufficiently sticky it makes little difference what part of the animal nor for that matter what animal it comes from Glue is often decidedly offensive to the nostrils because there is no particular need to keep out the bacteria that produce decay Almost any pure food will decay—unless steps are taken to prevent it But instead of saying that gelatine is a sort of glorified glue let us say that glue is often a debased and unclean gelatine Many of the manufacturers of gelatine also make glue generally in separate factories or in separated parts of the same general factory group By their knowledge and equipment they are better able to make it than others but they are decidedly careful about keeping these two branches of manufacture unscrambled Otherwise the pure food laws would reach out for them in short order Gelatine imported from the Netherlands is made from clean raw material and the processes take place in as clean an environment as only the scrupulously insistently clean Dutch people know how to maintain The old joke about the Dutch housewives getting down on their knees and scrubbing the very sidewalks is based on fact—they do it It is difficult to see how the husbands of these everscouring, irrepressibly energetic Dutch women can derive any solid comfort or repose from their home life

The full process of making gelatine requires from four to six weeks of continuous day and night work First the sun bleached degreased bones are treated in a vat for several days in a weak solution of muriatic acid Gradually the mineral matter in them such as calcium or lime phosphate and the carbonates of calcium and magnesium are dissolved out, leaving behind the material which contains the gelatine in its unfinished condition An experiment which is analogous to this process may be tried out by any one by placing a bone from the table in a weak solution of hydrochloric acid and leaving it several days. The instructive part of the experiment consists in the discovery, made after the solid matter is gone and a soft glutinous core is left that bone contains so much within itself that is not bone As much as 60 per cent of the volume of some bones consists of gelatine

The residue that remains in the vat after the treatment with acid is next washed many times with pure filtered water The purpose of this is to remove practically all of the chemical compounds formed when the acid unites with the minerals forming the rigid part of the bone Just as in careful chemical work, clean, filtered water is used for this purpose

Following this the stock is treated many times with lime water, removing any fats that may be present, and at the same time loosening the fibers and releasing the gelatine Then the stock undergoes several washings and goes to the vat for the next process, which is the boiling

The purpose of the boiling is simply to extract the gelatine since it is soluble in hot but not in cold water After the first boiling most of the gelatine rises to the top where it is drawn off Several successive boilings at increasing temperatures (necessitating that the liquid be contained in a tight boiler in order that higher temperatures may be arrived at) free practically all of the gelatine Of course the strongest gelatine comes off with the first boiling just as by far the most of the coffee is extracted from the coffee grounds with the first water

The gelatine which has been drawn off is now run through pipelines into a specially cooled room where the thin, hot liquid soon cools into a jelly like mass. It is then cut up into sheets and placed on nets over wooden frames which are conveyed to a long alley through which a strong current of hot, dry air is blown The purpose of this is to remove the moisture in the sheets and the greater part of it is removed there This puts them in condition to be ground up, ready to be packed in the common granulated form for use The long process of manufacture is now completed

But before it is put out on the market the gelatine must be tested and graded Each run is tested independently by several chemists, and these tests are of two general kinds. One has in view the determination of the number of bacteria, if any, present, the other, the percentage of unessential chemicals contained. In both these regards the gelatine must conform to the rigid requirements of the pure food laws of the United States, as well as the often more rigid requirements of individual States such as, for instance, Pennsylvania and North Dakota It is claimed that the gelatine imported from the Netherlands is higher in purity than the requirements of the American pure food laws demand

Gelatine is without doubt known by most of us as a dessert But there are other outlets for it that are still more important Most of it is used in the manufacture of ice cream in the United States than for any other purpose, this immense industry accounting for 8,000,000 pounds of gelatine annually This amounts to about double the quantity consumed as a table jelly The American candy industry uses another three million pounds every year

In addition to these uses, gelatine is found in a large and varied list of commercial products A few of these are pharmaceutical products such as capsules and coated pills prescribed by the physician Not a photograph could be taken, not a motion picture shown without gelatine although the gelatines used to coat the photographic films need not be as pure as those which regale us after a hearty dinner The standard set by the Federal food laws *for food gelatines permits*, out of one million parts (not one thousand) only 30 parts of copper 100 of zinc, 20 of lead 350 of sulfur dioxide, and 1 4 of arsenious oxide, or less than one part in 700 000 of the last named But many table gelatines are now made so carefully that they contain only one-fiftieth of those mineral allowances Thus they are fifty times as pure as Uncle Sam requires them to be

One of the chemical laboratories in a Dutch gelatine manufactory, where gelatines are tested

Relativity and Modern Physics

GENERAL attention has been drawn to the great number of volumes in which an attempt is made to present the elements of Einstein's theory to the popular reader At the same time there has been a considerable number of books offered, of more real scientific value, dealing with one aspect or another of relativity There has not, however, been a serious book upon relativity, for the serious student, which made a minimum demand in the way of technical requirements. Dr George D Birkhoff has now filled this gap in the literature with a book entitled "Relativity and Modern Physics" After dealing briefly with the classical physics, the book introduces its reader to the space-time idea, develops this quite extensively, and proceeds to the dynamics of a linear set of particles. Vectors and tensors in two dimensions are discussed, and tensor analysis developed sufficiently for the purposes in hand By way of a chapter on gravitation in two-dimensional space-time we pass on to the four dimensional continuum, and come to a climax in two chapters which show the bearing of the whole subject of relativity upon dynamics, electricity, and the theories of matter The book, Dr Birkhoff tells us in the preface aims at definite advances in the theory and a novel presentation of the subject, and we think it achieves both aims. The book should be of value not alone as a text for an undergraduate course in mathematics and physics in which relativity is to be dealt with—something to which our colleges must soon come, but equally to any person whose intellectual wants and educational equipment match, approximately, those of the upper layer of undergraduates. It is published by the Harvard University Press.

Geyser Heat for Iceland's Homes

IN Reykjavik plans are being made to make use of the neighboring geysers for heating the city The geysers are situated within a mile of the city and have long been used for laundry purposes. Now it is planned to make use of this never-failing source of heat by piping the water into the city in wooden pipes.

The Continuous-Motion Clock That Does Not Tick

A CLOCK in which the pendulum does nothing and yet regulates the timekeeping with great accuracy would seem an impossibility, but this epoch marking development has lately become an accomplished fact. In order to appreciate the importance of the new movement, which has been invented by Mr. Alexander Steuart, a clockmaker and electrician of Edinburgh, it is necessary to recall the faults of the mechanism by which pendulums have regulated clocks hitherto.

Almost everyone will have watched a pendulum swinging in a clock, while the escapement to which it is connected allows the escape wheel to move round one tooth at each swing. But between ticks what are known as the pallets of the escapement are sliding on the escape-wheel teeth, causing slight friction and unless the finest workmanship has been exercised in the making of the parts the clock will not be an accurate time-keeper. Again, wear affects the regulation of the clock, as does also the lubrication of the minute sliding surfaces.

Another drawback to the ordinary pendulum movement for certain purposes is that the second hand moves in jerks instead of continuously. For the ordinary timekeeper this feature is of no consequence but should it be necessary to record time in fractions of a second continuous motion is essential. This is employed in clock mechanisms for moving large astronomical telescopes and those which drive revolving drums for some instruments in which the measurement of time by fractions of a second is required. But the motion does not remain accurate for long owing to the lack of effective regulation.

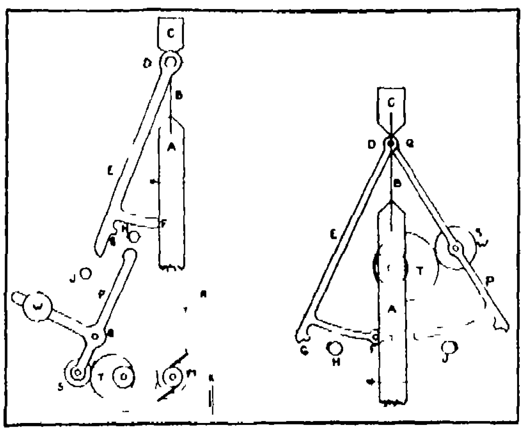
Mr. Steuart's pendulum movement overcomes both the above-mentioned drawbacks, being frictionless and continuous, while time-keeping within half a second a week of dead accuracy is easily reached. Referring to the left hand drawing which shows the movement diagrammatically A is the upper end of the pendulum which is suspended by the spring B. What is called a gravity arm E is pivoted at D, which coincides with the bending point of the spring when the pendulum swings. M represents a tiny electric motor which drives the eccentric T through the gear wheels indicated by dotted circles. The eccentric T, as it turns rocks the lever P through the roller S. The weight W on a cross arm of the lever keeps the roller always pressing against the eccentric.

We will assume the pendulum to be in the middle of its swing from left to right, the gravity arm by its weight applied at F giving enough impulse to keep the pendulum swinging. When the pendulum has swung a little further to the right, the contact G strikes the fixed contact H and allows electric current to flow through the motor from the battery K through the pivot D and the gravity arm the circuit being shown by dotted lines. In the meantime the eccentric T has moved forward allowing the roller S to swing to the right under the influence of the weight W. P therefore swings to the left and engages with the gravity arm raising it clear of the pendulum on its return swing until at the end of the movement the gravity arm is lowered on to the pendulum by the eccentric pushing P over to the right, and another impulse is given.

The motor naturally runs faster when current is flowing through it, that is, when G and H are in contact. It is kept running between contacts by a fly wheel and by a reduced amount of current which flows, through the resistance R. The longer the current flows therefore, the faster will the motor run and drive the clock. But the faster it runs the sooner will the eccentric cause the arm P to move the gravity arm to the left and so break the contact and reduce the current. This shortens the time that the full current flows, and therefore lessens the speed of the motor. In fact the combination regulates itself.

In actual practice the gravity arm and the lever P may be fulcrumed on the same pivot marked D and Q in the right hand drawing, while the eccentric is differently placed, but the cycle of operations is the same as described.

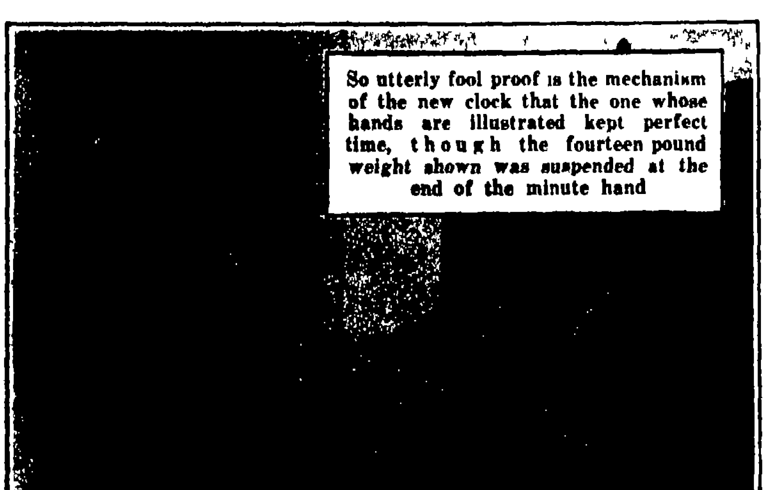
With the invention is attained a continuous motion suitable for driving astronomical telescopes while time-charts of recording instruments driven by it can be divided into fractions of a second. Electric bell signals can be made at any intervals of time without disturbing the pendulum. The driving power is not limited although that required even for large turret clocks is negligible. The heaviest clock can be regulated by a comparatively small pendulum. Extra friction in the form of snow on the hands of a turret clock has no effect other than to cause a temporary microscopic lag of clock time and longer periods of contact. Variations in the voltage of the driving current do not alter the average speed of the motor. Even missed or faulty contacts cause only slight temporary incorrectness. The performance is almost independent of fine workmanship. And finally, the clock is silent.



Left: Diagrammatic representation of the theory of the new clock. Right: Diagram of an actual installation

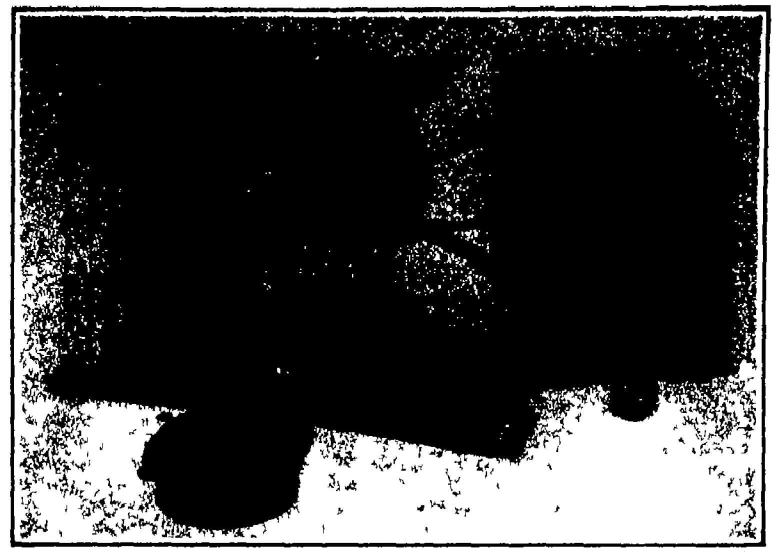
The electric clock that moves smoothly and keeps perfect time

A clock with a 20-pound pendulum working on this system keeps time within half a second per week. Greater accuracy than this is impossible unless the pendulum be enclosed in an air tight case. Incidentally it is quite possible to place the pendulum in a vacuum case deep underground where it would be free from variations of temperature as the clock itself may be at a distance.



So utterly fool proof is the mechanism of the new clock that the one whose hands are illustrated kept perfect time, though the fourteen pound weight shown was suspended at the end of the minute hand

The turret clock of which the hands are illustrated is driven by a 1/25 horsepower motor controlled by an 8-ounce pendulum. Even the 14-pound weight shown hung to the minute hand had no effect, in fact, the clock has kept accurate time with a 56-pound weight hung on the minute hand one foot out from the center. The mechanism of this clock is exceedingly simple consisting as it does of triple-reduction worm gear between the motor and the minute hand. It is believed that Mr. Steuart's movement is the most important development in clockmaking which has taken place in modern times.



The brake meter designed by the Bureau of Standards for checking up the effectiveness of automobile brakes

To Measure the Stopping Power of Automobile Brakes

A DECELEROMETER for making a graphic record of the behavior of an automobile when the brakes are applied has been invented at the Bureau of Standards and is being used for making tests of the effectiveness of brakes under various conditions. The instrument consists essentially of a heavy weight mounted on the upper end of a stiff spring with a pen and multiplying mechanism for recording the movement of the weight on a strip of paper. As the brakes are applied the inertia of the weight causes it to swing forward the extent of the motion being proportional to the rate at which the car is losing speed. The whole apparatus fits into a small wooden case and is placed on the floor of the car.

The curves drawn indicate the force applied by the brakes to stop the car and show how this force varies throughout the period in which the car is being stopped. In one of these curves a distinct break near the center was found at which point the braking force had dropped to less than half its normal value. On going back over the road the observers found a grease spot which the car had gone over at the time that part of the curve was being made.

In the accompanying photograph A represents the timer, B the weight, C the pulley for the wire connecting the timer to the timing pen, D the motor to drive the paper, F the motor to drive the timer, G the case for the weight and spring, H the switch and I the wooden case that encloses the whole apparatus.

Another pen, operated by a motor to which the tachometer is attached, puts on the chart a scale of time while still another pen permits of recording the time at which the driver is given the signal to stop. It is found that an appreciable time interval elapses between the giving of this signal and the commencement of the braking action, the interval varying with the car, the driver, and the driver's occupation at the time the signal was given. The average of a large number of tests with foot brakes was four tenths of a second during which time the car would have gone 12 feet if traveling at a speed of 20 miles an hour. The time intervals varied from 0.15 to 0.6 seconds. Considerable delay was found to occur if the driver was shifting gears at the time the signal was given, or if he had his foot on the gas at the time. The delay was much greater with the hand brake than with the foot brake.

Gets Russian Metric Rule

THE Metric Association of which Dr. George F. Kunz is President, announced recently that it had received a copy of the decree by which the Russian Government now permits the use of only metric weights and measures. "The new Russian laws covering weights and measures," explained Howard Richards, Secretary of the Metric Association, "throws new light on the relations between England and Russia. Heretofore the British quart, gallon and other liquid measures which differ by more than 20 per cent from the corresponding measure in the United States have been used to a limited extent in Russia. Hereafter any dealings the British have with Russia must be on the metric basis."

The Problem of Mine Fires

A NEW and determined effort to find a means of extinguishing the destructive fires that have been raging for years in anthracite mines of Pennsylvania is now being launched impelled by a number of new fires and the expansion of several old ones to the point where the emission of gases is beginning to constitute a threat to human life and habitations

For half a century the best engineers in the employ of the great coal producing companies and the scientists in the pay of the State of Pennsylvania and of the Federal Government have been trying in vain to find a method of extinguishing these fires To the engineer who is not familiar with the vast extent of anthracite mine operations and even to the layman with only a high school knowledge of physics the problem is superficially a simple one It would seem that it should be easy either to flood the burning section of the mine, or to seal up all openings and suffocate the combustion by a lack of oxygen Both methods have been tried but with indifferent and temporary success for reasons that will be explained

It has been suggested that all the old methods of attempting to control mine fires fail because they depend on time for their success The newest plan is to attack the blaze directly by an element that it is believed can be forced right up to the fire In addition to the gases thrown off by the burning coal it is proposed to mix some of the familiar chemicals discovered in recent years and which have a definite smothering effect All but two of the openings to a burning mine will be sealed under this plan One of these openings will be used to draw out the gases by fans A tank or compressor will be set up and the gas mixed with the smothering chemicals will then be pumped back into the mine under pressure

The engineers believe a gas can be prepared which will permeate whatever air pockets may be left in the mine to feed the fire and will still be heavy enough, particularly since it will be under pressure to stop any undiscovered air leaks The air pockets and the air leaks combine to interfere with the operation of both old methods of fighting mine fires A seam of anthracite it is generally known nearly always lies at an angle In workings of any magnitude this seam will undulate at some point or other When the mine is flooded the undulations create air traps so that the water cannot reach the fire

Sometimes one company will be operating on the upper end of a seam or slope, and another company on the lower If a fire starts in the upper mine water cannot be used to any extent without the danger of flooding the lower The great shortcoming of the sealing plan is found in the immense expanse of anthracite workings No one who has not been at least over the hills of the three great anthracite regions of Pennsylvania to view the countless breakers rearing their ugly heads can realize the extent of the catacombs beneath them. Some of the larger companies have been at tremendous expense to prepare maps which they believe to be complete showing every shaft and chamber of the diggings But it is not uncommon for them to find a forgotten drift, perhaps with the underground entrance hidden by crushed rock or slate

When a mine is sealed by the plan of concrete walls at all known openings surrounding a fire area and there is no diminution in the havoc, the operators sometimes dig trenches around the fire area and fill them with clay or even concrete The difficulty of the problem is perhaps best emphasized by this No one can tell definitely in which direction a mine fire will spread The direction of the seam at the last cutting may be known But there is nothing to show that it does not dip or rise just beyond that point and so far no method has been devised to get anywhere near a mine fire because of the intense heat and the smoke

Mine experts find that the popular opinion of mine fires is far from the actuality It is generally thought for instance that millions of tons of coal are consumed annually in the dozen or more fires now raging in the anthracite regions As a matter of fact the actual coal consumption is relatively small The damage done is mainly by the smoke that shuts off valuable workings and makes it impossible for the operators to take out any coal Thus sealing is resorted to not only to starve out the fire but also to keep the smoke out of adjoining operations And here the uncertainty of the old methods becomes increasingly apparent Sealing halts the fire only in known mapped chambers Fire in a mine never burns directly on the face of the seam that is it will not consume the solid vein It is the loose coal that burns But the heat from this causes a constant contraction and consequent cracking of overhead strata The pressure on the face of the seam breaks off more coal and this adds fuel to the flame An anthracite mine fire might be likened to a perfect automatic stoker with an unlimited supply of fuel.

With seals all in place the fire may eat its way slowly, during a period of years, through a seam until it gets into adjoining workings. Even if the fire area has been surrounded by trenches it may cut under the fire wall, or go through it This phase of fire spread is somewhat of a mystery It happens but no one knows exactly how It is a matter of record in several great mine fires, notably in the Summit Hill mine in Carbon County, where the fire has been raging for fifty years. A trench 250 feet deep was cut around this fire area It was four feet wide Wet mud was sluiced into this trench some years ago But the fire is now burning beyond the mud wall It is estimated that several million dollars have been expended in the effort to halt this particular fire The vein is one of the richest known, being sixty feet thick

That a fortune awaits the engineer who can develop a quick and certain method of extinguishing anthracite mine fires goes without saying The time when it was cheaper to abandon a mine, flood it and let it burn because there was just as much coal on the adjoining ridge, has passed Coal in tremendous quantities is still there but it is closely held, royalties are high and expenses of operation are greatly increased The larger operators particularly find their profits in working every available drift and they are determined to find a means of stamping out the fires. All sorts of efforts have been made to devise oxygen helmets that will permit adventurous miners, careless of life, to venture into the miles of tunnels filled with poisonous smoke There has been talk of asbestos suits in which those daring workers might penetrate through the intense heat, but nothing practical has ever come of either plan

Theoretical experts have been insisting for some years that the answer can be furnished by the chemist, but heretofore the mining experts have been able to find the flaw in most of the plans suggested The same experts hold that there are many problems to be solved in connection with the new plan before it will work but they are said to be agreed that it is the most feasible suggestion so far made not only to deprive the fire of its essential oxygen but to supply it with a suffocating chemical agency part of which is the very gas that the fire has thrown off A problem now being studied is to make this heavy enough so that it will seek the lower levels by its own weight displacing the air and gradually choking off every vestige of fire

Civilization and the Microbe

BACTERIA, germs or microbes are so small that fifteen millions of millions of them would scarcely balance an ounce weight Some of them kill us yet we cannot possibly do without them In fact without them we should all die far sooner than we would with them They seem to have evolved along with us and the other animals and now we are interdependent, at least with many kinds of bacteria

The many kinds of bacteria fall into three groups according to shape The spherical ones are called *cocci* the rod shaped ones *bacilli* the corkscrew like ones *spirilla* They are all colorless An averaged sized bacillus that which causes typhoid fever, for instance measures about one-twelve-thousandth of an inch in length That of "flu" is about half that length, according to Arthur Isaac Kendall Dean of Northwestern University, Chicago whose new work "Civilization and the Microbe" was written as a popular exposition of the activities of the microbe Here we are told that a bacterial individual grows by partition First it elongates somewhat beyond the normal size Then a slight constriction appears in the middle, and becoming deeper and deeper the individual divides into two exactly similar cells of equal size All this takes little time, for under favorable circumstances this newly generated individual will have given birth to a third generation within fifteen minutes

Many bacteria can row For oars they have *flagella* little "whips" whose diameter is about one two-hundred and fifty thousandth of an inch and by wiggling these in a manner quite like the motion of oars they are able to progress through a liquid at the alarming rate of four inches per hour—about as many inches per hour as a man can row a boat in miles

When living conditions do not suit them in case of heat or extreme dryness or cold microbes have the power to "hibernate" They form *spores* whose function is to increase the resistance of the residual germ substance contained within them so that they may survive not only heat and drought but some chemicals and long duration of time Some spores may be kept in boiling water for several hours without killing them while bacilli of anthrax which have been kept in dry storage since 35 years seem to be as good as new A mouse under whose skin they were injected died just as quickly as another mouse that received the same treatment from the same batch of anthrax germs 35 years ago

But not all microbes have the power to form the spores which carry them over hard spells and it is fortunate for us that they have not It is due to this fact that we are able to pasteurize milk simply by heating it to 140 degrees Fahrenheit, retaining it at that temperature during twenty minutes and then cooling it rapidly to 40 degrees Fahrenheit While this low heat does not kill spore-forming microbes it does kill or seriously weaken those which are pathogenic to man

The freezing of bacteria in ice kills off most of them This is not due to the direct effects of cold, but actually to the crushing done by expanding ice crystals A few generally escape but repeated refreezing further decimates their numbers Yet so great are their reproductive powers that it is by no means safe to assume that ice, because it is ice, is germ free Given a few survivers the whole community of microbes can regenerate itself in short order provided there is food—and there is plenty of germ food in the human body

One very old method of defeating the microbe without out actually killing him is to use salt That mineral has a powerful affinity for water—it wants water and will go to all sorts of ends to get it thawing ice for instance Salt acts as a preservative simply by blotting up the water that the germ has in his system, just as we have water in ours He either dries up and ceases to grow and sub-divide, or is actually extinguished Pickling or "corning" a method used by past generations for preserving food depended on a similar affinity of saltpeter for water In this manner some Egyptian mummies were preserved Sugar has a very similar effect, and honey may be similarly used as a preservative

Bacteria do not themselves injure us It is the poisons they manufacture and secrete which give us disease and often kill us These poisons are called "toxins" But the minute the body is invaded by these germ produced toxins it sets to work preparing its own anti toxins There is war If the body is in good condition it will probably be able to make enough counterpoison to whip the toxins But if there is too large a dose of germs or if a relatively small dose finds us weak and "run down" the germs win—unless a dose of anti toxin prepared in some other body generally that of a horse, rushes up reserves and saves the day

Modern sewage disposal depends on bacteria Here is a fine illustration of bacteria that are very helpful to man In sewage disposal plants the filter beds consist essentially of layers of sand, but it is not the sand itself that does the chief work of purification On top of the layer of sand there is kept a thin layer of microbes, a living carpet through which the pathogenic bacteria must pass, if they are to go on living The water which passes the layer of philanthropic microbes is so pure, not merely in appearance but in the sense of freedom from germs, that one of the regular show off acts of employes of sewage disposal plants is to drink the water as it issues from the filter beds

Ordinarily we are unaware of the presence in and on our body of many kinds of microbes, but they are always there Generally our skin is so intact that they cannot break through it and get into the blood But if the skin is broken these little opportunists at once seize their chance, enter and begin to establish themselves and multiply Some bacteria enter the body of man through the air he breathes This is especially true of those of tuberculosis and "colds" which are often caught as a result of the spray that floats through the air to distances of several feet after those who harbor the germs of these diseases cough or sneeze

In general, the sum total of microbic participation in life is overwhelmingly on the side of beneficence The notoriety that attaches to the microbes arises from the interference of a small but extremely formidable group of bacteria whose activities are in opposition to those of man and the natural outcome of the struggle between mankind and microbe has always favored man

ONE of the gigantic industrial achievements of the modern state, which often goes unsung while praise is being lavished upon some far less noteworthy item of civilization's structure, is the feeding of a great nation Without turning our attention at all toward the ways in which this task is accomplished we present herewith some figures that will show its sheer magnitude

The people of the United States spend for food \$49,000 000 per day—\$1,500,000 000 per month or \$18,000,000,000 per year Nearly one-third of this amount goes for bread, potatoes fruits, sugar and other food of vegetable origin The other two-thirds plus, is spent for meat, fish, eggs, butter, cheese, lard milk, etc In the course of a year, we consume over two and a half billion eggs and nearly ten and a half billion gallons of milk The eggs consumed in a single day if combined in a single shell would make an ellipsoid 90 feet long and 24 feet in its shorter, circular diameter—something beside which even the dinosaur egg of recent fame would shrink into insignificance And the milk bottle that would hold our daily ration of this vital food would be 885 feet high and 152 feet in diameter

To some extent there is duplication between several items of our drawing in which these and other facts connected with our daily food supply are shown graphically All these figures are got by dividing the year's production into 365 equal portions But the milk that went into the production of the butter, cheese and ice cream figured independently in the milk production as well We do not drink as milk 115 million quarts per day, or anything like that—if we did, it would mean a quart apiece per day a direct consumption that is not approached Our artist has been unable to separate the milk that is consumed direct from that which goes back into the manufacture of other foods however so the duplication is unavoidable We suspect also that his lard is included in the poundage of his meat animal as well as in that of the lard pail but of this we are not certain Even allowing for such duplication however the showing for our collective daily appetites is a most impressive one and it must be a source of continual wonder that an agricultural population whose numbers form an ever-dwindling percentage of the total population is able to keep up with the demand for the raw materials from which food is made

UNCLE SAM'S DAILY MARKET BASKET ITS CONTENTS IN DOLLARS AND CENTS AND IN MORE EDIBLE TERMS

Harnessing Arkansas Water-Power

How the Ozark State Plans to Develop the Facilities for Milling its Own Cotton

By R E Livingston

DURING the recent agitation resulting from Ford's offer to purchase the Muscle Shoals project from the Government Roger Babson said that should Ford's offer be refused, the great capitalist should not overlook Arkansas For this State has a larger percentage of navigable rivers than any State in the Union

For years Arkansas has been slowly forging her way up as a cotton State until last year, Government statistics placed her as ranking third in the production of the fleecy staple Yet Arkansas has practically no cotton mills aside from overalls factories and twine spinners The need has been obvious to citizens of the State but cheap power has been the problem the spinners of the east are facing the same problem

When it became known that manufacturers were handicapped because of this fact and that the manufacture of cotton goods in the United States would practically double if cheap power could be obtained a movement was started by capitalists of Arkansas to interest eastern capital in helping to harness the 13 navigable rivers of the State

Engineers and capitalists came from the East to investigate checking up the fall of the rivers the amount of cotton produced, and the attitude of manufacturers They found that 70 per cent of the cotton used in Massachusetts spindles is Arkansas long staple product They found that many eastern spinners would gladly build new factories further south to save freight and power expense Contrary to the usual idea prevalent regarding the State Arkansas is not flat but hilly with the exception of the rich river bottoms and the great rice fields in the southeastern part of the State Much of drainage and levee-work has commercialized these parts which formerly presented quite a problem

The entire northern half of the State is mountainous being in the Ozark chain while the foot hills rise abruptly here and there, south to the Louisiana line The mountains abounding in pine birch and gum which is shipped north and east in great quantities, offer inducements for utilizing the water power in the great lumber mills

The mountains are not of note for their height there being but two high peaks in the State Mount Nebo and Mount Magazine the latter being the highest peak between the Rockies and the Alleghanies But their abrupt cliffs and clustering peaks create much fall in the many mountain rivers and bayous

During the past year projects totaling the expenditure of more than forty million dollars have been launched some of which are two-thirds finished others completed and the greatest The White River project but barely started

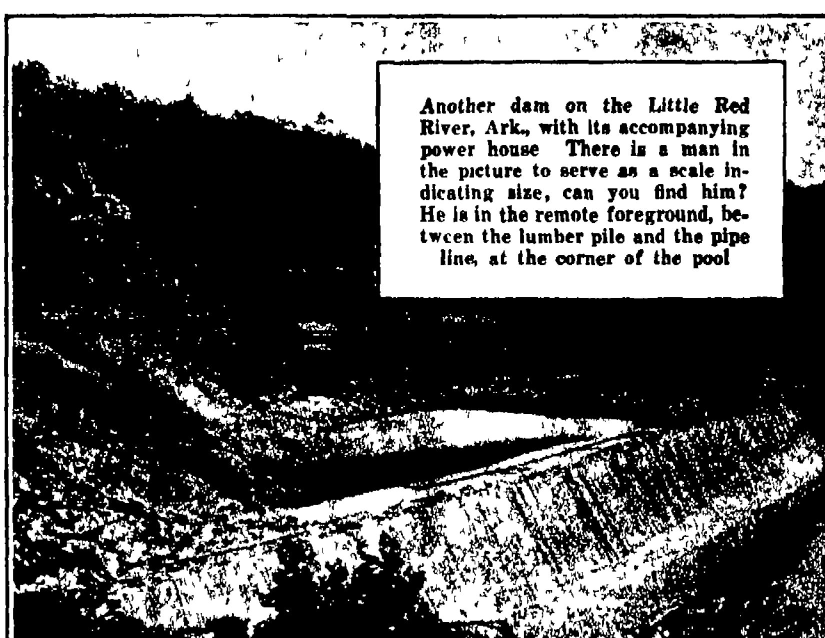
In the western portion of the State on Little Mulberry river dams have been constructed by local capital to the amount of one million dollars and the power is used to furnish electric lighting and for local mills

On Illinois Bayou in the midwestern part of the State a dam has just been rebuilt, which furnishes power for lights and machinery for half a dozen towns and for several coal mines and compresses This too is owned by State capitalists

But it is the gigantic White River project which will attract national attention for this will create more power than the great Keokuk dam and will be built by the same engineer Winding around old Round Top Mountain about whose nether parts the clouds hang their gauzy draperies, rippling eastward from Big Diamond Cave, creeps Buffalo river and its tributary, Little Buffalo and on the parent stream the first dam will be constructed This will cost, with its smaller dams, about twelve million dollars and will create 15 000 horsepower

The fall near Buffalo Shoal is 11 feet per mile more than twice the fall of the mammoth Muscle Shoal Number 2 dam is to go up near the town of Norfolk, on the North Fork river This will be a larger work than that of the Buffalo costing fifteen million dollars and creating 45 000 horsepower The waters will form a lake 100 miles long to be known as Dixie Lake, and extend over the State line into Missouri, and on up to the power site dam at Lake Taneycomo Including bays and arms that will be formed along valleys and canyons that lie along White river this lake will have a shore line of 400 miles This it is confidently believed, will be the largest artificial body of water in the world.

One of the smaller dams near Russellville, Ark., which supplies current for a number of towns



Another dam on the Little Red River, Ark., with its accompanying power house There is a man in the picture to serve as a scale indicating size, can you find him? He is in the remote foreground, between the lumber pile and the pipe line, at the corner of the pool

The largest and final dam of the eight forming the gigantic project will be the Dixie Dam at Cotter Ark, This will be 250 feet high cost fifteen million dollars and will have with the power from the smaller dams 200 000 horsepower When completed, this will be one of the largest in the world. The White river basin drains an area of 6200 square miles with an average annual rainfall of 46 inches. As some of the river bottoms have been subject to overflow in unusual seasons, the holding in check of the water will be a great benefit to land-owners throughout the region

The final checkings have been gone over, the moneys have been raised and it now remains for Mr Hugh Cooper, builder of the Keokuk dam, and head of this project, to push the work to completion. All surveys have been completed and much preliminary work done. Col Henry Allen, who served on the Panama Canal Commission under President Roosevelt, is chief engineer for the company, assuring the work to be in competent hands It will require nearly two years in which to complete the project

Another great engineering feat, nearing completion is the Red River project which is more than two thirds finished, and represents an expenditure of five million dollars, creating 30 000 horsepower This consists of three dams, one at Heber Springs, on Little Red river, the second some 20 miles eastward and the third on Red river proper, near the old college town of Searcy This region abounds in lumber, cattle, and small fruit raising which would profit greatly by cheap electric power being beyond reach of the natural gas fields in the western part of the State This bit of engineering has a natural rock base which has been the wonder and pride of the engineers in charge When finished this will supply a number of towns with electric power, aside from cotton mills which they hope to locate This construction has been put forth by local capital

A smaller project but a significant one, is that of the dam across Spring river in the north-central part of the State, near Imboden This will cost one million dollars and create 5000 horsepower It is owned locally, and is a part of the great concerted industrial movement of the State

Turning southward we come to a two-million dollar project on the Ouachita river near the great oil fields Much cotton is raised in this portion of the State, and a deep waterway will be constructed, whereby cotton may be floated down by steamer to the Mississippi, and on to New Orleans, thereby gaining a great saving in freight rates. Oil tanks, filled from the local pipe lines can be put upon barges and sent to the gulf to supply the ocean liners

At Arkadelphia where one of the dams will be constructed, are situated some of the largest flour mills of the south, which will readily utilize much of the new power created There has been no organized movement among the people of Arkansas for hydraulic power yet one project encouraged the launching of another, and the assurance that the great Dixie project was actually to be carried to completion, gave assurance to those interested in the furthering of the great industries of the State

A Submarine Gold Mine

DIVING for $32,000,000 is a form of sport that should amuse any one, whether a diver or not, if he were promised one thirty-second of the treasure During the war the steamship Laurentic, laden with gold to the extent of the sum named was sunk off the coast of Ireland in ninety feet of water by a German submarine Since 1918 the divers who have been at work on the wreck have brought up the entire amount of gold, in addition to almost $5,000,000 in silver specie During the first three years of the work only 608 bars of the precious metal were recovered, but after the adoption of the galvanometer in connection with a prod with which contact is made with the bars of gold, 2100 bars each worth from $5000 to $10,000 were recovered, in addition to the silver as stated.

The Size of Stars

ON December 13, 1920, the angular diameter of a star was measured for the first time in history with an apparatus devised by Prof A A Michelson Hitherto every star had appeared as a mere point of light, and no test had been able to differentiate it from a geometrical point But on that eventful evening a 20-foot interferometer constructed at the Mt Wilson Observatory was turned on the star Betelgeuse and the measurement revealed that this star had a disk *one-twentieth of a second of arc in diameter—about the size of a halfpenny 50 miles away* The distance of Betelgeuse is known roughly (unfortunately it cannot be found so accurately as the distances of many stars) so that we can convert this apparent size into approximate actual size Betelgeuse is not less than 200 million miles in diameter The orbit of the earth could be placed entirely inside it, as has already been shown pictorially in the columns of the SCIENTIFIC AMERICAN

"The stars are thus not limited to objects of comparatively small bulk like the sun there are among them individuals truly gigantic in comparison We can add another step to the astronomical multiplication table—a million earths make one sun ten million suns make one Betelgeuse This is a comparison of volume not of amount of material It leaves open the question whether, in order to obtain one of these giants we should take the material of ten million suns rolled into one or whether we should take the material of the sun and inflate it to ten million times its present size There is no doubt that the latter answer is nearer the truth Betelgeuse contains more matter than the sun (perhaps fifty times as much) but in the main its bulk is due to the diffuseness with which this material is spread *out* It is a great balloon of low density much more tenuous than air, whereas in the sun the material is compressed to a density greater than water

"Whether the star is one of these balloon like bodies or whether it is dense like the sun depends on the *stage of its* life at which we catch it It is natural to think that the stars gradually condense out of diffuse material so that they become denser and denser as their life history proceeds We can now see in the heavens samples of every possible stage in the development of a star The majority of *those seen with the naked eye are in the early diffuse* stage, that is not because these young stars are really more numerous, but because their great bulk renders them brighter and more conspicuous The young diffuse stars—the giant stars—can be studied more advantageously because we understand much more about the properties of matter when it is in the condition of a perfect gas than when it is condensed although the difficulties of treating a dense star like the sun are not insuperable, we have naturally made the most progress with the easier problem of giant stars —*Abstract from an article by Prof A S Eddington, F R S in Nature for May 12, 1923*

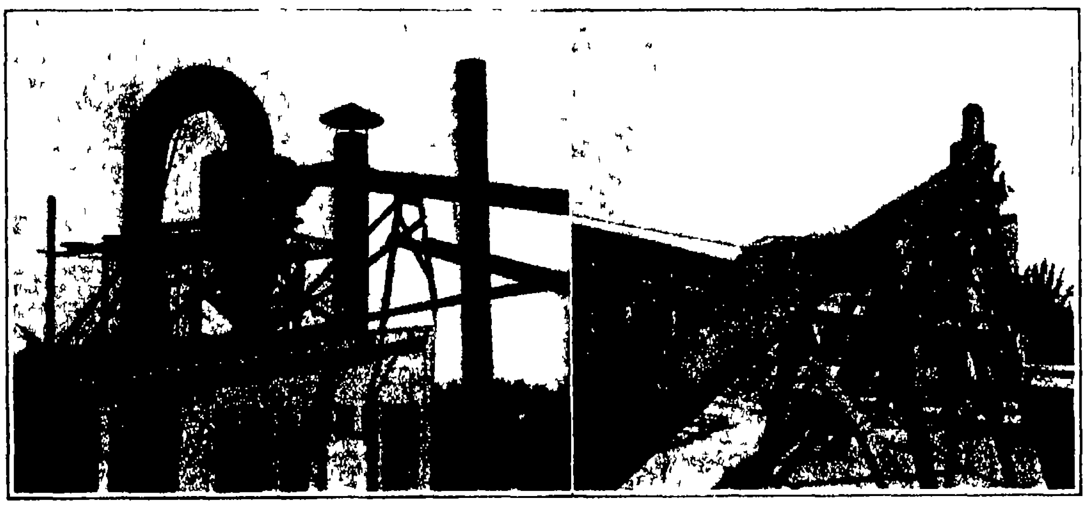
A Novel Gadget for the House-Painter

THE painter of houses has always been puzzled for a way to plant his ladder against the side of the house without making a mark on the freshly laid paint A way to accomplish this is now offered him in the ingenious ladder support *illustrated On each upright* of the ladder, near the tip is clamped a curved brace, the other end of which is pointed These two points, one on either side of the ladder, furnish the bearing points for the ladder There is not enough pressure to mar seriously the surface of the wood and the paint, as such is obviously not affected at all The two supports between them straddle sufficient width to dodge the widest window niche as our picture indicates and they offer an extraordinarily convenient place from which to suspend the paint pot

Placing the painter's ladder without marring the fresh paint which he has left above him

The Previousness of Science in India

TO prolong the life of man for thousands of years to melt precious stones and pearls and give them desired shape size and color to enable a man to fast for six months or more without losing health and life to cause new teeth to grow in the place of fallen teeth—such are some of the benefits to mankind revealed by an ancient library belonging to Dr Syed Md Kassim Jahagirdar Head of Pasteur Hall Pathargatti Hyderabad This library contains rare and valuable ancient books and manuscripts on palmyra leaves written in almost all the languages of India Some of them seem *to be the works of the hoary Vedic period* In one book is described a kind although it fails to specify exactly what kind of wireless telegraphy in which two stone plates are to be prepared and placed at great distance from each other without any wire connection It is said that communications can be carried thousands of miles by means of these Jules Verne came too late!



Sugar blowing system which sucks the sugar up and delivers it to the sirup mixing room

Factory Messengers on Tricycles

ONE of the seemingly simple, but actually vexatious problems which developed when the East Pittsburgh plant of the Westinghouse Electric and Manufacturing Company grew to a floor area of 91 acres on which 30,000 persons found employment was the distribution of interdepartment mail including blue prints and bulky files of manufacturing data

To cover all the essential points required a walk of ten miles so messengers on foot were altogether too slow for a busy plant as a trial conclusively demonstrated Next, six electric trucks were tried but these proved too much like turning a fire engine loose in a china shop The trucks were promptly discarded

Then some genius suggested that boys on roller skates might make the rounds at acceptable speed without creating too much disturbance or being too much in the way Forty boys were mounted on roller skates and turned loose in the vast buildings The boys had a glorious time while it lasted

As a last resort a tricycle with a box about three feet square by a foot and a half deep was procured and a girl was employed to ride it The problem was solved

Now a mail carrying force of 25 girls makes the rounds at frequent intervals, making promptly unerring delivery of the material so essential to the operation of the plant The girls are clad in neat blue uniforms They attend strictly to their business Their tricycles have solid wheels so the skirts of the riders cannot catch in spokes The rubber tired machines are noiseless The only sound ever heard from the post girls comes from the chime whistle which each carries at her belt to sound as a warning when turning corners

How inter-departmental mail is delivered in one of Pittsburgh's largest factories

Sugar Blower System for Cannery

THE accompanying photos show a sugar blower system which is installed in a cannery The sugar is emptied into a metal box and is sucked up by a powerful fan and blown through a large pipe in to the sirup room When sugar passes through the fan and pipes at such a terrific velocity a small percentage is pulverized This is very hard to separate from the air and is done by means of a stocking leg auxiliary to the cyclone separator Sugar can be carried hundreds of feet in this manner

Life in the Ocean Depths

MONOTONY is strikingly characteristic of the eerie deeps which well nigh all types of marine *animals from* microscopic forms to fishes have made their abode There are no seasons — uniform winter, endless night Yet with a perfectly uncanny adaptability protoplasm flows as serenely in temperatures sometimes below the freezing point of fresh water as in limpid pools of tropic reefs There are no bacteria and no living green plants A ceaseless drizzle of small organisms that have succumbed in the ocean meadows (perhaps miles above) slowly settles like gentle snow on the ocean floor and provides food for multitudes which in turn fall prey to others in thousands of cycles

Deep-sea animals are much more delicately constructed than their shallower water relatives many having bodies thoroughly permeable to water Sedentary forms such as frail phosphorescent sea pens arborescent polyps and tall sea lilies or crinoids rear themselves above the mud while quaint spiny crabs with spindly legs and egg shell bodies vie in slimness with the pycnogonids grotesque all legs neither spiders nor crustaceans In the branches of these miniature forests of tree-animals dwell thousands of different species of all sorts of types On and within the ooze are other myriads—bristling sea urchins sea stars and sea cucumbers, inconceivably delicate shrimps molluscs and worms

When we ascend a great mountain the vegetation and animals change with increasing altitudes Broad belts of approximately equal temperature have a uniform assemblage of plants and animals So it is when with the long arm of the dredge we follow the bottom into deep water The lighted zone along shore teems with life unlike that at one hundred fathoms while at five thousand fathoms still another world is seen and so on with increasing depth That temperature is the most important factor seems likely for at five thousand to one thousand fathoms for example off California are found relatively shallow water subarctic types—*Abstract from article by W K Fisher in The Scientific Monthly for October, 1923*

The Heavens in March, 1924

Eclipses and Other Subjects Discussed at the Meeting of the Astronomical Society

By Professor Henry Norris Russell, Ph D

THE HOLIDAY season is by a custom of long standing packed full of meetings of scientific societies—and discussion now and then arises among their members whether it is more profitable to have one great meeting in some large city which every one attends or a number of smaller ones in various places each covering a special field. The Astronomical Society this year followed the latter course with results which more than satisfied those who were present. Meeting at Vassar College—whose busy campus is as empty as any other between Christmas and New Year—the seclusion and the opportunity for continual conference, formal or informal, filled every moment with profit. The list of papers presented was not long—only about 30—but this permitted full discussion, and increased rather than decreased the value of the program. As usual some of the most eagerly discussed topics were of only technical interest but as was to be expected, many of the best were of general interest.

Perhaps the most central topic of interest dealt with eclipses past and future. Had not the elements been so sadly inclement last September we should have heard much more but fortunately one American party—mainly from the Swarthmore and Allegheny Observatories—chose a station far in the interior of Mexico, where in spite of a torrential rain but a few hours before the obscuration of the sun good observations were secured.

Professor Miller the head of this party told us his story both in technical form and later, informally at a public lecture. The latter was illustrated with admirable moving pictures taken by one of the great commercial concerns who delegated a camera man to accompany the expedition from beginning to end. The resulting film gives an admirable idea of the activities of an eclipse expedition the laborious building of mountings and adjustment of instruments—and ends with excellent pictures of the gradual progress of the partial phases the corona during totality and the uncovering of the sun's disk afterwards. It may be cordially recommended to any one interested in astronomy.

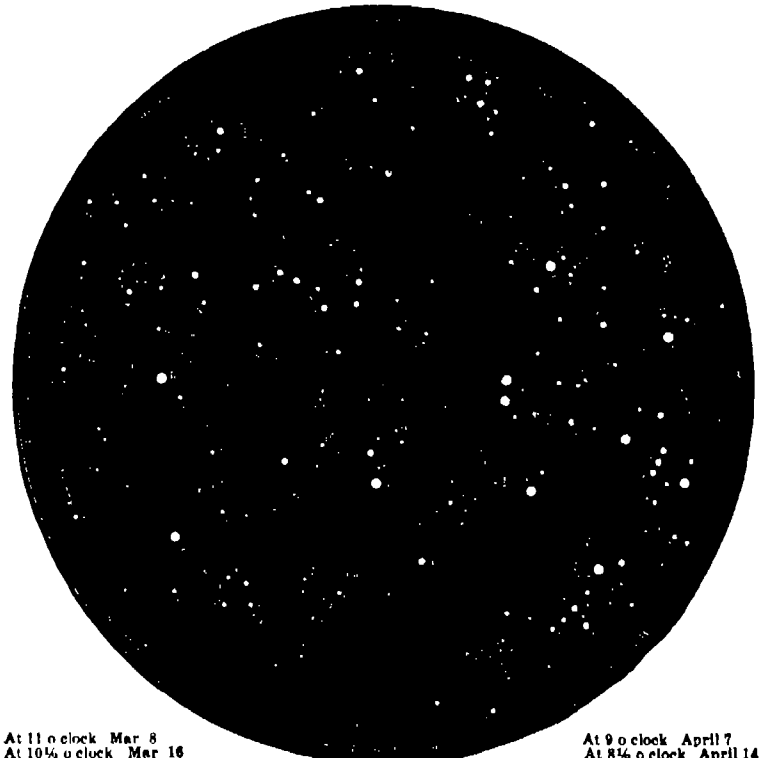
The scientific results included some admirable photographs of the corona and some starplates not yet measured—for the Einstein effect. The most noteworthy novelty however comes from the spectrogram by Dr Moore of the Lick Observatory who accompanied the party and photographed the spectrum of the corona to detect its rotation. The result was unexpected. Instead of finding the lines in the spectrum of one side of the corona displaced toward the red, and those of the other toward the violet *both* sides showed strong shift toward the red. That is the coronal matter on *both* sides of the sun is receding from us.

A theoretical explanation lies close at hand. It has long been realized that the force which holds the corona up and keeps it from falling into the sun is the pressure of the outgoing solar radiation. If this pressure slightly more than balances gravity the coronal matter will be driven away from the sun. Such an effect was detected by Miller through comparison of photographs of the 1918 eclipse made at different stations and is now confirmed in this quite different way—the rate of uplift being found in both cases to be about 20 miles per second.

The Layman as a Scientist

But the discussion did not end with past eclipses. The coming event of January 20th 1925 was much in every man's mind. It is rarely that the track of a total solar eclipse covers such accessible and densely settled country. Poughkeepsie itself Danbury Ansonia and New Haven and Montauk Point are almost on the central line and the zone within which totality occurs extends north as far as Springfield Mass and Providence while its southern limit passes between Wilkes-Barre and Scranton and right across the backbone of New York City, in the neighborhood of Central Park.

Though the weather prospects are mediocre the duration of totality of nearly two minutes is long enough to make observations well worth while. Should the sky be propitious every one will have his chance. Not merely the professional astronomer with his large instruments and the amateur, with his more modest equipment but the "man in the street" too can render real service to science. If some one at every street corner along New York's long avenues should stand, watch in hand, and note simply for how many seconds the sun was hidden from him by the moon we would have the equivalent of a very accurate observation of the moon's position in the heavens and if similar observations should be undertaken, on a larger scale all over New England New York and northern Pennsylvania and New Jersey, the results would be of correspondingly increased precision. More is likely to be heard of this in the press—and probably in these columns—before many months have passed.



At 11 o clock Mar 8
At 10½ o clock Mar 16
At 10 o'clock Mar 23

At 9 o clock April 7
At 8½ o clock April 14
At 8 o'clock April 22

At 9½ o clock Mar 29

NIGHT SKY: MARCH AND APRIL

The Variable Star Algol

One other noteworthy paper dealt with eclipses but eclipses of a very different sort—those of the star Algol by its large but faint companion. Mr McLaughlin, at the University of Washington, has taken more than 150 spectrograms to determine the orbit of this star and finds that its velocity curve is very curious. The usual changes are clearly shown—the bright star receding from us before eclipse and approaching us afterwards but during the eclipse itself the smooth and orderly progress of this change appears to be interrupted and the curve shows two regular "humps"—which however, are far from being objections to the eclipse theory.

Algol is doubtless in rotation as well as in orbital revolution and both motions are in the same direction. When we observe the star outside eclipse, we get light both from the side which is carried toward us by the rotation and from that which is receding. The light of these different parts of the star gives lines shifted to the violet or the red as the case may be but in the combined light of the whole star this produces merely a widening of the lines of the spectrum. When, however Algol is going into eclipse the preceding side, which is turning toward us is hidden and the other side is clear—so that we get a clear shift of the observed lines toward the red. When Algol is emerging, the other side is obscured, and the shift is toward the violet. The observed peculiarities may thus be explained, to the point of accurate numerical agreement, and the rate of motion of a point on the star's equator, due to its rotation, may be found. If the periods of rotation and of revolution in the orbit are equal (as is probable, but in this particular case not quite certain) we can then calculate the diameters of Algol and its companion, and the masses of both. It thus appears that Algol is of a little more than three times the sun's diameter and a little less than five times its mass, while the companion is almost equal in mass to the sun but of only one-fiftieth the sun's density, and therefore larger in diameter than Algol itself.

It may be remarked that these calculations depend upon the assumption that the star's disk is equally bright all over. If, like the sun, it is less luminous at the edge the diameters and masses of the components must be greater though not enormously so.

One more communication of quite a different sort, may be mentioned. Professor Brower of Yale since the completion of his great work on the lunar theory has been devoting his interest largely to the asteroids, and especially to the remarkable group of planets which have periods almost identical with that of Jupiter. Considering first the effects of Jupiter's attraction, he finds that though the asteroid orbits may undergo considerable changes, they will remain of the same general character. For example a given asteroid will always remain on the same side of Jupiter as seen from the sun and at a distance of about sixty degrees from Jupiter. But when the attraction of Saturn too is taken into account it appears that the combination of certain slow changes in the motion of these two great planets produced by one another with certain other changes in the asteroid orbits will produce further alterations of the latter, which though very slow will continue steadily for an enormous interval of time, and may ultimately lead the little planets into entirely different orbits from those which they occupy at present.

The Heavens

The splendid winter constellations—Orion Taurus and Canis Major—are now low in the west with Canis Minor, Gemini and Auriga above them. Perseus is low in the northwest and Cassiopeia in the north. Draco and Ursa Major are high in the northwest, Virgo and Boötes well up in the east and Leo high in the south, with Hydra below.

The Planets

Mercury is a morning star before the 22nd and an evening star afterwards, but is too near the sun to be seen. Venus, however is splendidly placed, an evening star far south of the sun remaining in sight until 9 P M at the beginning of March and 10 P M at the close. Mars is in Sagittarius and is slowly approaching quadrature, but still ranks as a morning star.

Jupiter is in the same part of the sky, about 9 degrees west of Mars on the 1st and 22 degrees on the 31st. He comes into quadrature on the 9th. Saturn is some 45 degrees further west, in Virgo, and comes to the meridian about 2 A M in the middle of the month. Uranus is in conjunction with the sun on the 8th and is invisible this month. Neptune is in Leo, and comes to the meridian around 10 P M.

The moon is new at 11 A M on the 5th, in her first quarter at noon on the 13th full at 11 P M on the 20th and in her last quarter at 3 P M on the 27th. She is nearest the earth on the 23rd, and furthest away on the 11th. During the month she is in conjunction with Mercury on the 4th Uranus on the 5th Venus on the 8th Neptune on the 17th, Saturn on the 23rd, Jupiter on the 26th, and Mars on the 28th. She also eclipses the sun on the 5th, but this eclipse is only partial at best, and visible only in part of South Africa.

At 4 A M on March 20th, the sun crosses the celestial equator, and "spring commences."

Moving Houses One-Third of a Mile on Narrow-Gage Tracks

MOVING houses on narrow gage tracks is a plan that has been tried out successfully at Hagerstown, Md. Eight of the buildings to be moved were six room frame houses, and one was a 12-room brick and stucco house. Although the ground was in celery ridges, yet with the use of a road grader a good roadbed was established and then the tracks were laid on narrow gage ties. Four pony trucks of four wheels each were coupled together from track to track, using a 6 x 10 timber with a truss rod. Then a 14 x 14 timber, 44 ft long, that rested directly over the king bolts, coupled up each set to suit the length of the building to be moved. Needles 12 in. x 12 in x 36 ft. were used as carrying timbers.

All of the houses had cellars 6½ ft deep By grading down and removing the foundation walls the movers could back the hauling frame under each house. Coming up crosswise to them, it was necessary to give each house one-quarter turn to place it on the platform Rollers were used for this turning As it was necessary to use a sharp curve at the new sites, the rear end of the buildings could not land over the lot just right This was remedied by laying the tracks on past the location and then the tracks were opened back in the rear and thrown over by crowbars so that each house would land just right when backed up. Wherever it was necessary to turn a house completely around, it was done by using two sides of a "Y," as railroad engines are turned

The double brick house was rolled on six nests of iron and wood rollers, a 4 x 12 shoe was used, lined with one half steel plate, 7 ft long Under each end wall of the building a steel eye-beam, 6 x 20—40 ft long was placed, and three pieces 12 x 12 were placed up under the joist Then 12 x 12 s, 36 ft long and steel eye-beams 5½ x 15—36 ft long, were used every four feet centers, as cross needles, coming up under with a timber 14 x 14—44 ft long under which were placed shoes and nests of rollers

The track was filled up level with the surface of the rail with 4-inch crossing plank, with third rail laid in the center making a complete track of 3-ft gage The time for truck moving was 10 ft to the minute for the rollers moving 2½ ft to the minute

The power for hauling was an improvised capstan, with a ⅝ in cable 610 ft long, all anchored to dead men ahead, using snatch blocks around curve, wound up by a horse to an 11-foot sweep

The frame houses each weighed about 100 tons and the brick about 250 tons These houses were moved to their new location through a peat marsh but the work was accomplished with but slight damage

House placed on railway trucks, ready to be moved, and the sturdy cradle on which the houses were carried on narrow gage railroad tracks

The "Chemical" Sense

THE mechanism of the senses of smell and taste is apt to be unduly neglected, probably on account of the fact that in civilized man these senses do not play a large part in intellectual processes. But they bring before us some interesting problems as to the nature of receptor organs in general It will be remembered that the object of such organs is to excite a set of nerve fibers on the incidence of some external agency of such a kind or intensity as to be unable to affect these nerve fibers directly This is done by the production of some powerfully stimulating agent in the specially developed and specialized receptor mechanism at the terminations of these nerve fibers.

It is difficult to define satisfactorily the difference between taste and smell If it be said that the former relates to substances in solution, whereas the latter relates to vapors, we are met with the fact that even vapors must be dissolved in the watery layer covering the olfactory cells Moreover, the presence in fishes of a mechanism which appears to be the same as that of smell in air breathing organisms suggests the need of some other criterion When we come to attempt to correlate either smell or taste with chemical composition we are met with serious difficulties

The sense of taste is shown to include at least four distinct senses—sour, saline bitter and sweet Experiments show that the fish is aware of the position of the stimulus turns to it and swallows the meat The response is absent when the nerves to the taste-buds are cut

Then sensations produced by various chemical irritants are to be distinguished from those of pain although both are devoid of differentiated receptor organs and are mediated by free nerve endings The chemical sense is said to be abolished by a smaller dose of cocaine than is the sense of pain They have in common, however, a high threshold value, as would be expected from the nature of the structures stimulated As the object of the sensibility is mainly to avoid injury, too great a delicacy would clearly be a disadvantage. The olfactory sense is regarded as the most primitive, that of taste the most highly developed with the common chemical sense as intermediate in evolution —*Abstract from "Nature", for May 12, 1923*

Longest Reinforced Concrete Bridge of Its Type in the World

FRENCH engineers have been strikingly successful in the design of long span bridges, in which particular attention has been paid to the matter of artistic appearance In many instances they have shown positive daring by departing from conventional methods where the exigencies of the site or the above mentioned desire to secure beauty of appearance were controlling factors Every visitor to Paris must have admired the Alexander Bridge with its slight rise of only 17¼ feet as it spans the Seine from bank to bank

Another beautiful bridge of long span was opened for the service of the public by President Millerand on October 14th of last year likewise bridging the Seine This structure is claimed to be the longest reinforced concrete bridge of its kind in existence The length of the span is given as 390 feet and the highest point of the arches rises to 97½ feet above the river The bridge provides a roadway sufficient for two lines of traffic with two sidewalks for pedestrians flanking the roadway

The most striking feature of the bridge is the two main bowstring girders of reinforced concrete the cross-section of which increases gradually from the crown to the abutment The girders are braced together only at two points one near each abutment This portal bracing serves to maintain the arches in their true relative position and prevent any distortion or overturning effect due to lateral wind pressure The floor system also has been so designed as to assist in carrying the wind loads and transmitting them to the abutments

The floor of the bridge is supported by twenty pairs of vertical suspenders which extend from the arches to twenty transverse floor beams One of our illustrations shows very clearly the construction of these floor beams each of which consists of a Warren truss extending across the full width of the bridge and sufficiently beyond the balustrade to permit the vertical suspenders to take hold To protect them from the weather the floor beams are encased in concrete and upon them are laid the longitudinal stringers and the concrete roadway surface

The engineer's calculations were verified with great accuracy in the loading tests which were carried out upon the completion of the bridge The provisions for stresses due to dead, live and wind loads and to changes of temperature were most carefully worked out and in spite of the severity of the test loads, the concrete has been singularly free from cracks or other disfigurement

Left: **Underside of bridge, showing the floor beams** *Right:* **End view, showing massive portal bracing**

Handsome reinforced concrete arch bridge of 390 feet span, across the Seine at St Pierre

Unique Radio Museum

A NEW kind of museum has been begun Realizing that the time will come when new generations will be interested and curious to know what manner of apparatus was used or rather "put up with" in the present or early stages of the development of radio a Cincinnati manufacturer of radio apparatus has placed in a small museum adjacent to the broadcasting station WLW several early types of telephones, such as the old mechanical or vibratory diaphragm "tincan" telephone used in 1845 and the crystal receiver as first used before the perfection of the vacuum tube Various forms of apparatus connected with radio which will probably soon be superseded by better go to make up an exhibit which will be of great interest to the radio fan of the future

The Engine as a Brake

What Happens When We Roll Down-Hill with Gears in Mesh and Ignition Off

By Numerous Readers and the Editors

SELDOM have we had a more enthusiastic response to an invitation for general discussion than was manifest in the reactions to our editorials of February and March, 1923, on engine braking Never has the general level of comment been higher We had planned merely to have a correspondence page of these letters and of extracts from them, but they are too good for treatment other than in a regular article This has been delayed by the fact that the automobiling member of the staff is the psychic member, who has had all he could do and a little more, these few months But, at last, here it is —THE EDITOR

FIRST among the objections advanced against the use of the switched-off engine as a brake is the claim that the muffler is likely to be blown out The explosion in the muffler after switching on the ignition occurs because the first hot exploded charge catches up with the last cold, unexploded charge, igniting the latter But the remedy is as simple as the cause As the car nears the point where the power will be required the clutch should be disengaged and held so for a second or two until after the ignition switch has been closed In this brief interval the engine, now free slows rapidly under the retarding force that enables it to act as a brake, and when the first exploded charge reaches the muffler the cold charge that preceded it isn t there—it has reached the atmosphere There will be no back fire, and no blow-out muffler

As evidence of the sufficiency of this practice it works with the flivver Lizzie has no truly neutral position of her clutch wherever the pedal stands if the high speed does not drag the low will The editorial flivver has been braked in this fashion on hundreds of hills if not thousands and the muffler is the one part of the original car that remains On a car with a positive neutral position of the clutch, then one may be completely insured in this way against back fire in the muffler

More serious is the matter of oil dilution In the absence of an explosion and of a hot blast in the exhaust the incoming mixture remains relatively cold and far less effectively carburetted and in this state it cuts the oil film from the cylinder walls and from the pistons At the same time as the engine cools (rapidly, see below) the ring clearance becomes greater All this means more gasoline in the crank-case oil

Most cars have on the dash a device for enriching or thinning the carburetor mixture while the engine is running When this is not supplied it usually can and should be added for present day conditions make it almost an essential With it the driver with an eye for details coasts with a mixture that is almost entirely air preventing excessive oil dilution and saving gas

Mr F C Butler of Cleveland, has the one brand of popular carburetor that does not permit dashboard adjustment He has installed a valve whereby he can admit air into the intake above the carburetor either in limited quantities through a needle valve for lean running or in such large amounts as completely to cut off the function of the carburetor ' He opens this valve wide when coasting with the engine as a brake He thus gets a maximum of freedom from oil dilution and of gasoline economy and incidentally is relieved of the necessity of touching ignition or clutch

Mr Butler remarks that when he opens this valve while coasting, he can feel the car jump forward as though relieved of a load 'This is slight he says 'but none the less evident Any driver who will open the throttle suddenly while coasting will be able to duplicate this verification of our statement that the closed throttle gives the maximum braking power Numerical valuation of the advantage comes from Mr Otis Presbrey a Brooklyn engineer Tests made under his direction with two familiar automobile engines, a four and a six, yield the results summarized in the attached table Both engines were driven through a dynamometer, the four at 810 revolutions per minute corresponding to a high gear car speed of 19 75 miles per hour, the six at 820 revolutions or 16 76 miles

Few of our readers proved themselves sufficiently poor observers or poor reasoners to disagree with our bald statement of fact But numbers of them disagreed more or less fundamentally with our analysis of the causes We said Every iota of energy spent in the compression is returned, during the dead stroke by the pressure of the expanding air against the moving piston ' Though we immediately made it clear that this statement referred to the ideal case that never occurs and that in any actual engine there was dissipation of the compression energy in various directions several of our readers are quite certain that one of these channels of loss is wider than our remarks would indicate From what is said by Mr Presbrey, Mr V E Jakl of Washington, Neb, and Dr C C Mintner of Newark, N J a very complete discussion of the adiabatic action during the compression and expansion strokes could be given

Theoretically an adiabatic process is completely reversible, and we get exactly as much work from a gas by expanding it as was spent in compressing it. Actually, the fact that the compression process heats the gas renders a 100 per cent return impossible, for there is no way to prevent the radiation and conduction of this heat The loss corresponds to loss of part of the compression energy we can expand the gas *ad lib* and we shall never be able to get this energy back In the case before us the debt is paid by the moving car, some energy *is* absorbed and some braking done on the compression-expansion half of the cycle

The exact amount of this loss—or in this instance gain since we are in the unusual position where the more energy we lose the better off we are—depends upon numerous factors The conduction coefficient of the cylinder walls the rapidity of water circulation and the radiator efficiency the engine speed as measuring the time available for distribution of the lost heat the initial temperature of the cylinder walls as indicating the amount of heat which they can absorb from the compressed gas—all these and other items figure Though we are sure that those who attribute the major part of the braking to this effect are wrong the loss in this direction is certainly larger than a hasty first glance would indicate Evidence of this is seen in the extreme rapidity with which coasting cools the engine

Several correspondents make this point, but only Mr W A Garratt of Covington, Ky, brings out the utility of the coasting procedure in cooling the engine after a long climb In our own experience this is one of the major advantages of compression coasting A cooling system that will keep the engine temperature down below 200 degrees Fahrenheit when the engine is firing, will obviously cut it far below that point in the absence of combustion heat So intense is this cooling effect that after a long coast, we always have to enrich the mixture temporarily in order to insure that our engine fire regularly When we reach the top of a hill with the engine boiling, we find that we can cool it more expeditiously by slipping down the other side with the dead engine in gear than by standing at the summit waiting for Nature to take her course

How the Engine Develops Braking Power

Throttle position	Retarding force of engine on car: Four	Six
Closed	84 5 foot-pounds	130 9 foot-pounds
One-eighth open	72 1 "	110 0 "
One-quarter open	68 5 "	99 0 "
One half open	61 6 "	96 4 "
Three-quarters open	61 6 "	93 0 "
Wide open	61 1 "	93 0 "

There are other channels through which the compression energy may be dissipated Mr Jakl points out that there is a thermal effect on the intake-exhaust half of the cycle if we brake with closed throttle The intake stroke then rarefies and cools the entering air, and renders it capable of absorbing more heat from the cylinder walls than it otherwise could

Again, piston rings are never absolutely tight, and as the engine cools they get looser Compression energy leaks away through them and is never regained Then, too, the valve-spring resistance is against the engine on opening and with it on closing Failure of the springs to attain absolute elasticity measures the difference between absorption of power in opening and return of power in closing

Still another feature of the cycle, which we must confess we had overlooked entirely, is brought out by Mr S W Taylor of Allentown, Pa, Mr J E. Padgett of Indianapolis, and Mr V V Gunsolley of Minneapolis. The intake and exhaust valves are differently timed, making the compression range considerably greater than the firing range Quoting

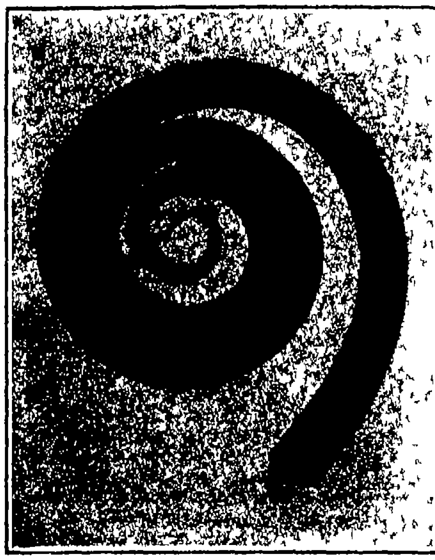
"The intake valve closes for the compression stroke anywhere from 20 to 40 degrees past lower dead center, and the piston compresses the air until it reaches top dead center—a range of 160 to 140 degrees. Then the compressed gas reacts on the piston and helps force it down But this does not last as long as the compression, for the exhaust valve opens anywhere from 65 to 45 degrees before bottom dead center The expansion stroke has then a travel of only 115 to 135 degrees' If this were merely a matter of the time available for expansion, there would be faster emission of heat and a balance would be struck But when the valve opens compression is in part replaced by discharge The entire body of air never returns, *in the cylinder*, to its original volume or temperature It takes out the exhaust with it heat which it would have to give up to the cylinder walls if it were to maintain an adiabatic balance

Mr W R Ward of Lyells, Va, makes another interesting point Intake and exhaust passages are of different contour, the resistance offered to air-flow by the intake being much the greater The closed throttle brings the intake resistance to its maximum the open throttle does the same for the exhaust That is to say, when we close the throttle, we maximize the thing that has the biggest maximum Mr Presbrey s figures take added interest here, indicating that a very little opening of the throttle breaks up the intense vacuum in the intake and seriously affects the braking power

Of all our original assumptions, that which caused our readers the most uneasiness was our ignoring of the running friction of rear axle, transmission bearings, etc Numerous readers insist that this friction accounts for most of the braking power This we cannot admit Mr J E Meikle of Castle Rock, Wash., Mr W A Kelley of Brooklyn, Mr J E La Mont of Manhattan Kan, Mr Gunsolley and Mr Padgett all discuss this phase of the situation interestingly Mr Padgett cites the Bureau of Standards experiments, described on page 82 of our February issue Here we learn that to pull a certain car in neutral required a tractive effort of 70 pounds, while to attain the same speed in high and low gears required, respectively, 110 and 220 pounds But the Bureau here made no effort to separate the running friction from the absorption of power by the engine cycle We do not know just how this separation might be made, but the anecdote we are about to set down will indicate its general result

Our car had been overhauled by a mechanic who suffered an obsession about getting everything extremely tight It is his custom to make bearings and pistons so tight that, before the car can be run under its own power or before the engine can even be started, the car must be towed for some miles with the engine in gear With our car, the first attempt to do this failed signally, the "towed" car was merely dragged along the ground without rotation of the wheels. The spark plugs were therefore removed, and the intake and exhaust manifolds taken off With compression and pumping stresses thus eliminated, the towed car ceased sliding and started to roll without further difficulty It would appear from this that, even with bearings absurdly tight, the absorption of power in the operation of the engine cycle is greater than the loss through running friction, and that it is really the engine, and not the bearings that acts as a brake.

Uncommon Views of Common Insects



The tongue of the butterfly, magnified 23 diameters

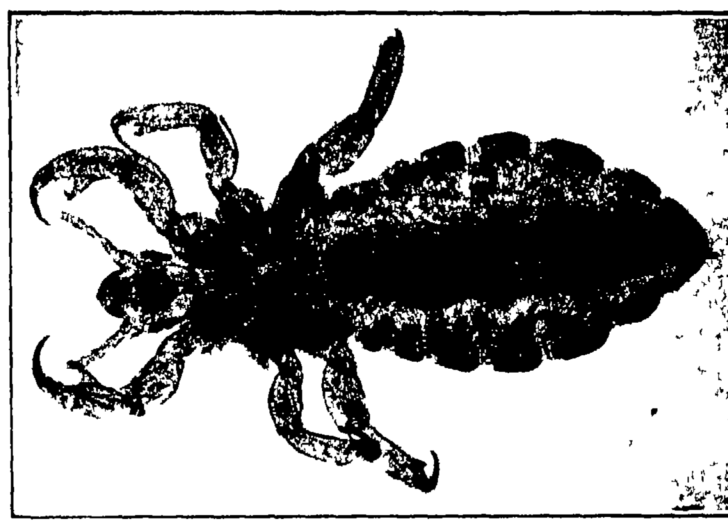
The foot of the spider, magnified 50 diameters

Tongue of bumble bee, magnified 100 diameters

The tongue of the common house fly, magnified 40 diameters

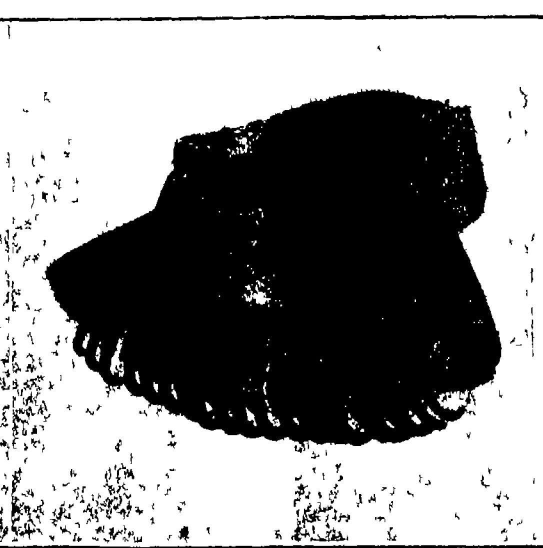
Interesting portrait of the sheep tick, magnified 8 diameters

THESE excellent photomicrographs were made by Miss Mary Allard Booth of Springfield Mass whose work in this field has won for her world wide recognition Miss Booth has prepared a collection of photomicrographs of parasites for the Bureau of Entomology of the U S Department of Agriculture The essential apparatus for photomicrography consists of a microscope with a firm base placed in a horizontal position lenses and a camera The lower power lenses are always known as dry lenses The higher power lenses are chiefly what are known as immersion lenses that is to say between the specimen and front lens of the objective an immersion fluid sometimes water but usually cedar wood oil is used The object of this immersion fluid is to enable a wider beam of light to be utilized by the objective



Our old friend, the "Cootie," magnified 25 diameters His Latin name is Pediculus Vestimenti

Side view of human flea, male, magnified 20 diameters



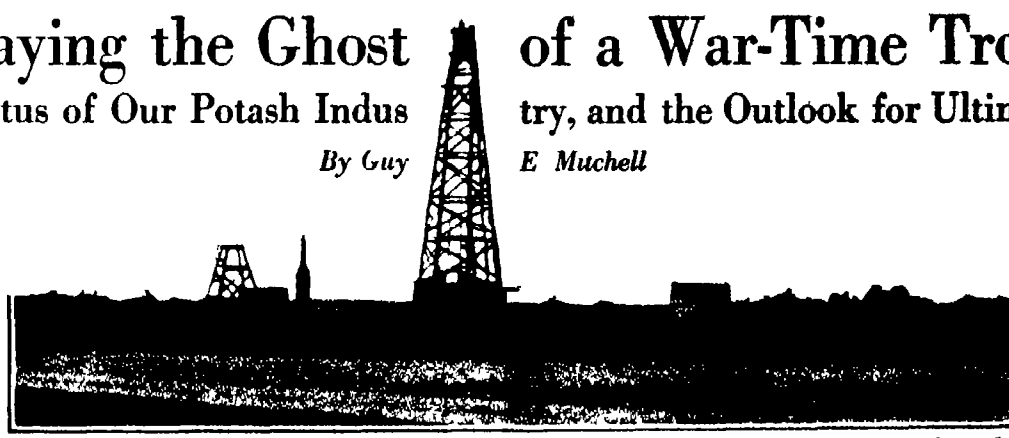
The foot of the caterpillar, magnified 33 diameters

Bubonic plague flea of rat, magnified 33 diameters

Laying the Ghost of a War-Time Trouble

The Present Status of Our Potash Industry, and the Outlook for Ultimate Independence

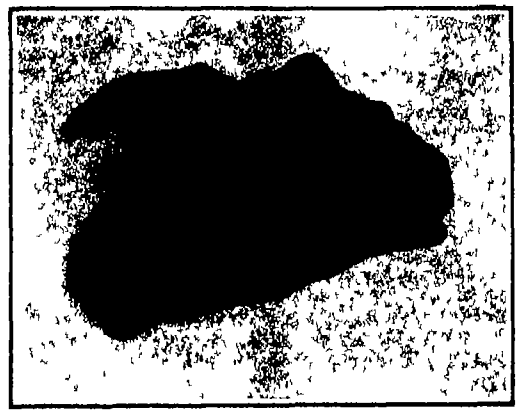
By Guy E Muchell



Oil-well drilling in the Texas potash country—Reagan Co., where observations and analyses by Government geologists show underlying potash beds

THE United States Geological Survey has announced the discovery of potash in the West which it is believed may develop into a find that is comparable to, may even be larger than the huge Stassfurt deposits of Germany If so its value will be almost beyond calculation It is hardly necessary to mention the importance and value of potash The problem of getting cheap potash is one that will affect the pocket book of every person in the United States Potash like phosphorus and nitrogen, is one of our vital needs No plant can grow without it Unless there is potash in the soil we cannot produce a loaf of bread or a pound of meat a vegetable or a fruit And the available supply at the present time is very hard to get—Germany controls it We have again become practically dependent on Germany for our supply of potash salts in the United States Last year our production of American potash was only 11 714 tons (K_2O) When the German exportations were cut off by the war the United States was driven to extremes to produce sufficient potash for our minimum requirements but in spite of very strenuous efforts comparatively little was accomplished Some potash was produced from saline lakes in the Middle West and in Death Valley, California at a cost to manufacture several times that of the German potash and during the period of the exclusion of the German potash some potash was also extracted from western alunite rock deposits Attempts were also made to extract commercial potash from kelp the huge sea weed of the Pacific Coast and this is even now being done to some extent but is only possible on account of the valuable by products It seems strange that while the huge deposits of potash salts of Germany and Alsace-Lorraine are the only known large deposits in the world potash is nevertheless one of the most abundant minerals It is found in whole mountain ranges of rock here in the United States as well as in other countries rocks which are known as potash rich —containing relatively large percentages of this mineral The trouble is that Nature has locked the potash up so tightly in these rocks that no method has yet been developed which will release it except at a prohibitive cost Scores of processes have been evolved on account of the tremendous demand for potash and many of them patented, but no process has yet been developed on a commercial scale which will anywhere near supply the demand

Potash is also obtainable in limited quantities as a by product in the manufacture of cement and other products but all of these sources of American potash are either very limited or the cost of extraction too high to enable them to compete with the great German deposits If we are to compete with these foreign deposits we must either develop a chemical process for cheaply extracting the potash from the unlimited supply of potash rich rocks or we must discover and develop some great natural supply of potash salts like the German deposits The chemical method will doubtless be realized some day but the discovery of natural potash deposits seems to be the most promising at this time. The United States Geological Survey has been engaged for a number of years in exploratory work mostly in the West since geologists have believed that there must be somewhere great natural deposits of potash salts, but the ridiculously small amount of the appropriations available has permitted of government test drilling only here and there and of more recent years, observations of private drilling operations carried on primarily for oil These latter have however convinced the geologists that there exists in Texas a great deposit of potash salts Oil being the objective of all these drilling operations and not potash salts, the records kept by the oil men have been of limited value The evidence gathered by the Geological Survey however, strongly indicates that we have in West Texas, and probably in Southeastern New Mexico, beds of potash salts within 1200 feet of the surface a depth workable by mining shafts, and extending through large areas Some of the drillings show large percentages of potash and it is pretty certain the geologists state that in this region the nation possessed enormous reserves of potash This



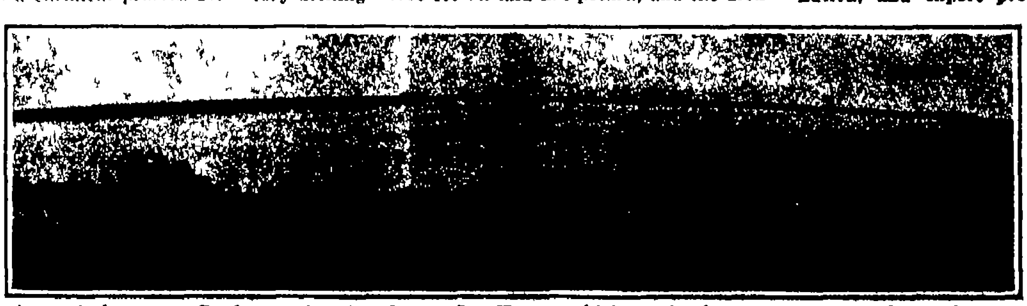
Mineral sample from the new Texas potash field, with potash content of 12 5 per cent

region is part of the great Red Beds region of the Southwestern United States where we have a series of sandstone, shales, limestones, etc which through an interval of 1000 feet more or less carry beds of salt estimated by the Geological Survey to contain 30,000 billion tons of rock salt It is the greatest known salt field in the world The rock strata are similar in composition to those carrying the vast potash deposits of Germany and they were formed at the same period of the earth's history, and under largely similar conditions, and it has been generally assumed that potash if present would be found in this region of the greatest salt deposition in the West Potash salts have been discovered in these salt areas, but as stated the exploratory drillings were for oil and not potash, and the drillings have been so mixed up that the potash beds have not been clearly defined. But it is a fact that potash has been found here there and yonder, over an enormous area—about 275 miles long by 125 miles wide To definitely determine where the potash deposits are located will require the sinking of core driven wells, an expensive operation, but one which when successful will be rewarded with one of the most important necessities in both times of peace and war

Kainite is one of the natural potash salts of the German Stassfurt deposits which is largely imported into the United States in a somewhat impure state and sold direct to the farmers It contains in such commercial form about 12 per cent potash (K_2O) and sells for about \$15 or \$16 a ton. The most promising and significant of the Texas potash investigations comes from the Means well in Loving County which has been drilled to a depth of over 5000 feet, and analyses made by the United States Geological Survey for potash of every five feet of material drilled These analyses show all the way from a trace of potash to more than 11 per cent (K_2O) A number of relatively rich potash beds were encountered by the drill From the 1240 to the 1245 level the potash content was 6 41 per cent , from the 1245-1250 level it was 8 97 per cent, from the 1250-1255 level, 4 per cent and 1255-1260 level, 3.22 per cent Here is an average of 4½ per cent of pure potash in 20 feet In the 1735-40 level the analysis shows 4.82 per cent the 1740-1745 level, 9 per cent, and the 1745-1750 level 7 92 per cent, while the 990-995 level analyzed 11 21 per cent The potash is in the form of a hard salt known as polyhalite which has about the potash value of kainite Absolutely pure polyhalite contains 15 6 per cent potash (K_2O) so that this 5-foot bed contains comparatively little impurities. It is water soluble and requires no treatment other than crushing or grinding to be used as a direct fertilizer It remains, of course, to be determined how far these beds extend and this can only be realized by further drilling but geologists are of the opinion that the drill will show the beds to be persistent and that it will be strange indeed if thicker beds are not discovered Considering this 11 21 per cent analysis, which is the most favorable yet determined, let us see what we have The specific gravity of polyhalite is 2 67, so that a five-foot bed would yield 17,690 tons of potash salts containing 11 21 per cent (K_2O) to each acre What the cost of mining would be is not here considered but at current market prices to the farmer we have a potential value per acre of perhaps \$250,000 In short, commercial potash salts have been discovered in the United States.

Potash as we all know is a prime farm necessity As our farming soils become poor, we must stimulate them with fertilizer—the three important constituents of which are potash, phosphate and nitrogen The more widespread and effective fertilization of the soils of the United States is not merely an agricultural requirement, it is a national necessity upon which depend the commercial welfare and prosperity of the country in the near future Our national financial independence cannot be sustained indefinitely by the use and export of the products of even the greatest mines in the world We must continue, as in the past, a great agricultural nation, and export products which can be replaced The replenishment of worn out soils is one of the very biggest things before this country today and well recognized as such Americans are very fond of saying and hearing that their enormous production of corn, hay, fruits, vegetables and live stock is the backbone of the United States; but the wearing out of American soils constitutes a menace to this nation, the disastrous and far reaching significance of which is little realized by a public habitually optimistic and complacent. It is simply voicing the opinions of some of the most level headed men of the country to say that this question of farm fertility is the most important economic problem of the United States and that beside it our war debts are trifling and ephemeral This is a strong statement —that compared with the importance of this problem of the continued fertility of our farming lands, our

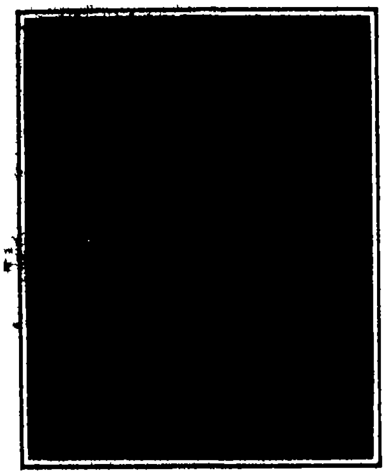
(Continued on page 216)



Arm of the great Cardona salt lake, Crane Co., Texas, which lies in the newly discovered potash area

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



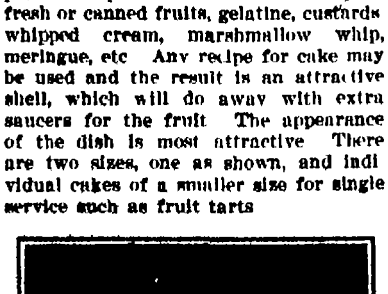
Reservoir and siphon of the home soda-water fountain

A Soda-Water Plant in the Home

SOME years ago an inventor introduced a siphon which charged itself from liquid carbonic acid gas contained in capsules built to withstand the enormous pressure. Such siphons are now being sold once more. The device we show, however, is different in that the liquified gas is contained in a metal tank or bottle so that the siphon can be easily charged. The bottle has a real "valve-in head" and there is a gage and a release valve on the tubing. To charge it is only necessary to fill the siphon which will hold 44 fluid ounces with water preferably distilled. The holes in the safety casing show the height of the water to be carbonated. The cap shown in the foreground is unscrewed from the charging tube in the siphon head, the flexible tube is attached with the aid of a screw nipple and the gas is allowed to flow from the bottle at a pressure of 160 pounds until the siphon is charged. An automatic blow-off valve releases the gas when carbonation is completed.

A Cake-Shell Pan

THE cake baking pan, which we illustrate, is made of one solid piece of aluminum, as it has been found that this metal brings a more even heat to the dough or batter than any other. This pan is adapted to form a cake shell for fresh or canned fruits, gelatine, custards, whipped cream, marshmallow whip, meringue, etc. Any recipe for cake may be used and the result is an attractive shell, which will do away with extra saucers for the fruit. The appearance of the dish is most attractive. There are two sizes, one as shown, and individual cakes of a smaller size for single service such as fruit tarts.



For baking cake shells to receive fruit fillings

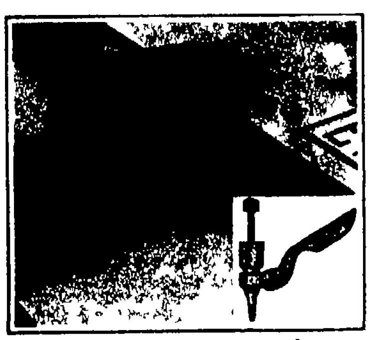
Wrenches of Chrome Vanadium Steel

THROUGH the use of chrome vanadium steel, a forge and tool works of Allentown, Pa., has been successful in developing wrenches that are thinner, longer and stronger than the usual carbon steel wrenches of the same opening. The use of this alloy steel allows refinement of design, both in shape and thickness of head. The thin pear-shaped head, made possible by the use of alloy steel, makes this line of wrenches lighter, better balanced and more serviceable in confined places, combined with unbreakable strength. These chrome vanadium steel wrenches are available in sets of assorted sizes to fit a wide range of U. S. Standard nuts, S. A. E. nuts and hexagonal cap screws.

The same works have introduced chrome vanadium tappet wrenches—long, thin wrenches which allow the mechanic to work clear of the motor when it is hot—the only time for adjusting—while the angle of the heads allows him to reach inaccessible positions. As most cars require three wrenches to make complete tappet adjustment, these wrenches are designed so that two can be worked with one hand while the third is used in the other hand. This is accomplished by having two openings both the same size but at different angles on each wrench. One opening is straight while the other is set at $22\frac{1}{2}$ degrees.

The Tubular Ruling Pen

MOST steel lettering pens have to be selected for stiffness of nib to suit the particular user. Too much ink on the pen causes blots and poor intersections. A tendency to bear too heavily spreads it and makes vertical strokes wider than horizontal ones. The great care necessary in these connections it is claimed is obviated with the use of a new tubular pen which is supplied in connection with a goose-neck member which enables it to be used with any ordinary pen holder. Being tubular, lines of uniform strength are insured no matter what the direction of the stroke or the pressure behind it. Ink is placed, by means of a dropper, in the little cup on the shank of the pen; the member projecting above this reservoir is a cleaner. It is carried in this position for use as a primer, a function which it performs through its very slight projection beyond the nose of the pen, so that it scrapes on the paper and vibrates in such manner as to agitate the ink. Any mark it makes obviously, is in the path of the pen itself and is swallowed up in the line which the latter draws.



The latest drawing pen, and the way to use it

One of the major advantages claimed for the apparatus is that it is used with a stroke practically the same as that of ordinary penmanship.

The Vest-Pocket Seal

SOMETHING decidedly clever in seal presses is offered—nothing less than a pocket seal. As our picture shows it looks very much like an ordinary watch case, the places on the inside ordinarily occupied by the dial and the sweetheart's photograph being filled by the two faces of the press. The illusion is heightened by the handle, which is in the design of a watch stem, so that when closed and put away one has in one's pocket to all external intents a watch. In use the paper to be stamped is placed between the two faces which are closed down upon it and one then delivers as much of a knock-out punch with the closed fist as may be necessary to transfer the impression.

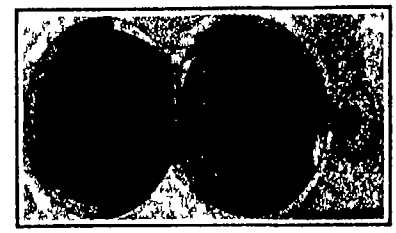
Knife and latch key in one, for small pockets

A "Tuxedo" Knife

MEN'S dress clothes are thin and a bunch of keys is apt to make an ugly looking bulge. After the dinner or party is over one must go home and the latch key must therefore be carried. An inventor conceived the idea of introducing a key into the end of a knife which is often carried at the end of a watch or key chain. Naturally every pin or Yale lock as they are usually called is different, so a blank is furnished and not a key, but with the little key duplicating machines it is possible to cut in the proper notches in a minute. If it is not convenient to do this the knife and a key may be sent to the manufacturer who will make a key out of the blank and return to owner. It will be noticed that the pattern on the knife frame is carried on the handle of the key which forms a part of the frame when the key is thrust home.

A New Electric Siren

THE little electric siren is only a few inches high but is little in size only, for the screech of this little red head is terrible. This is supposed to be an "indoor" size but it would answer for a small town perfectly well. A steam or air siren is all right where pressure is obtainable day or night but this is often difficult, while electricity is always available. The small size which we illustrate is only 10 inches high and is actuated by a one twelfth horsepower motor. The relatively large rotor is surrounded with a wire screen to keep out birds and sleet and is equipped with a sheet metal roof which also serves as a sounding horn and distributes the warning in all directions. As a burglar alarm for banks it is particularly useful as it may be sounded from any point. This siren has several elder brothers which are all right for outdoor use and render fire signalling easy.



A seal press that is built in the pattern of a watch

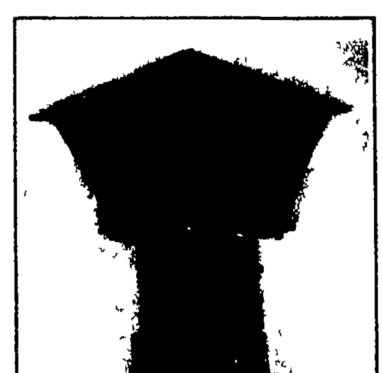
Machine for Testing Gears

A GEAR tester has recently been developed and placed on the market. The instrument is primarily intended for ground gears but can be used equally well on cut gears for developing, checking and charting involute curves and testing tooth spacing.

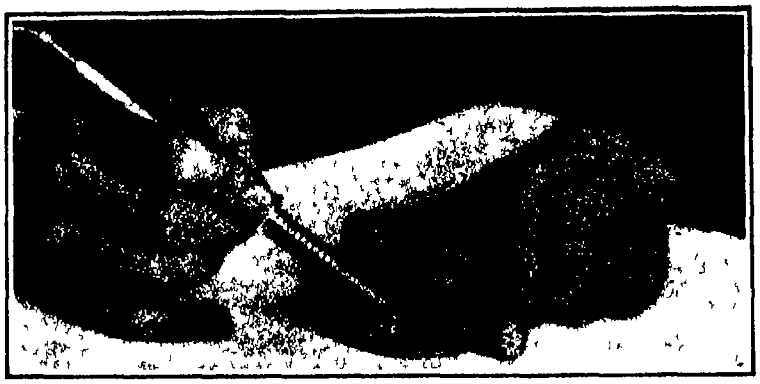
The machine consists of a base with a longitudinal slide upon which a transverse slide is mounted. Both slides are moved by screws with hand wheels and micrometer heads. A slot is machined at one end of the base, in which a stud for mounting the gear to be tested is clamped. On the transverse slide are mounted the contact finger or needle and an indicator by which the readings are taken.

For testing the involute curve of a tooth on a spur gear an adapter with a base circle disk and steel tapes 0.005 inch thick are used. The indicator may be set to read direct or to multiply the readings by four. It is evident that as the transverse slide is moved the contact finger will trace a true involute relative to the gear, since the tapes cause the slide to move a distance equal to the peripheral motion of the base circle disk. To take readings the transverse slide is set at zero and the contact finger is set at right angles to the slide by means of a gage. The gear is then set on the stud with the indicator reading zero and if the indicator remains at zero as the transverse slide is moved the tooth curve is shown to be a true involute. Any deviation from the true involute is shown on the indicator and may be charted. To assist in gathering data for charting the curve a plunger automatically retards the handwheel every 0.010 inch. The charted curve for a true involute will be a straight line.

Tooth spacing is checked by using a



Electric siren that works from any light socket

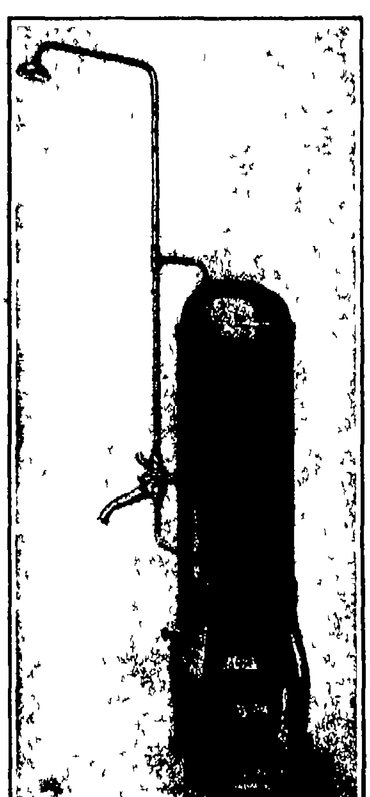


Electrically heated soldering iron for small work

fixed contact finger clamped to the slide, in connection with the indicating device. Tooth to tooth spacing or 90-degree spacing may be checked. When it is desired to maintain a master curve or duplicate an established form the longitudinal slide is used, first plotting the master and then checking the other curves with the chart. By making special adapters spiral bevel and other gears may be tested for spacing and contour. The normal capacity of the instrument is from one half to eight inches, spur, helical and bevel gears, and the maximum is up to 12 inch spur gears.

A Portable Hot-Water System

EVERY mail these days brings us pictures of devices being marketed in Germany for making one shovelful of coal do the work of two. Among the latest group of these interest attaches to the portable hot water heater which we illustrate. This as far as we can make out in the absence of adequate details from our correspondent is connected on to the house water system presumably by running a hose connection to a faucet. When the fire burns the water circulates, in the familiar thermo-siphon fashion inside the cylinder until the valve to the bath tub spout or that to the shower connection is opened. It is just like the familiar kitchen boiler of the American home, save that it can be taken to any room—and, in the absence of hot water pipes in the plumbing must be taken to any room in which it is to be used.



Hot water without hot-water pipes

Make Your Own Pie Charts

IF you want to show where a dollar goes or where your receipts come from a divided circle or "pie chart" is generally used. Formerly, we had to draw a circle and then divide it roughly

Rapid and accurate gear testing

into degrees and calculate the percentages, draw radii and then color the segments. Then along came the graphic stationer (who can sell two or three hundred different kinds of rulings, bar charts, circles, maps, etc.) with a hand some circle divided into percentages and only waiting for the radii and the color. Now we have one more improvement by which for the small sum of thirty five cents, you can make a colored pie chart in an instant. The charts are 4¼ inches in diameter and consist of seven disks divided into one hundred parts, with graduations on the outer edge. There is one cut from the center to the periphery which allows a disk of another color to be inserted; this operation can be repeated until the seven disks have been utilized. It is seldom that there is necessity for dividing the circle into more than seven segments and the percentage of each can be determined in an instant. It is a real time saver and will prove useful in any office.

The Motor-Bike Fire Engine

DECIDEDLY surprising must be the verdict of one who sees for the first time what a complete fire fighting equipment it has been possible to mount on a motorcycle as illustrated herewith. There is carried a side car in which the chemical equipment and tools are packed, and on the forward part of the body a rugged iron cage for the stowing of 150 feet of hose. Suspended on the sides of this cage are four carbon tetrachloride fire-guns for combating gasoline fires, and others of the sort. On the rear of the side car are carried two larger extinguishers of standard chemical types. Inside the car there is a reducer valve for connection between the regular 2½ inch hydrant and the ¾ inch hose carried. There are in addition numerous fire-fighting tools of the usual sorts, all this comprising part of the equipment supplied by the maker.

The Soldering Iron for Small Jobs

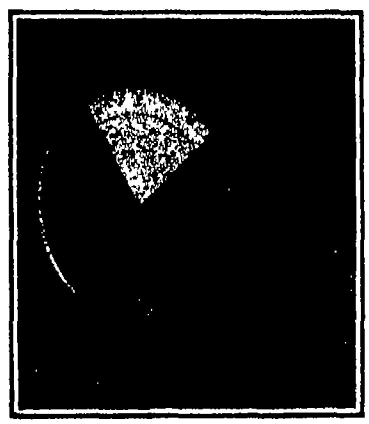
SMALL soldering, like any other small work, demands the use of a quality instrument, and not a large cumbersome tool adapted for entirely different work. We illustrate an iron designed to meet this need. Constructed entirely of metal it is fitted with a German silver tip insuring minimum oxidation, consequently infrequent renewal, leaving a clean, smooth surface at all times. Heating is by electricity. The heating element is composed of the highest quality nickel chromium. The cord is protected, where it enters the handle, with a light metallic spring coil, which prevents fraying or other wear at this vital point. In operation, the hand is comfortably near the soldering point, enabling one to work speedily, economically and visibly—which is not the case when using a big tool as a makeshift. The iron according to the maker operates on any voltage and either alternating or direct current, and may be used with the standard screw socket or the base plug.

Transparent Metals

IT has long been known that thin sheets of gold and silver, mounted on glass, may be made transparent by heat, but it is only within recent years that serious study has been given to the conditions under which such transparency may be obtained.

It is said that a sheet of gold one three-hundred thousandth of an inch thick becomes transparent when heated to 550 degrees centigrade. The transparency is ascribed to the gold aggregating and allowing white light to pass through the interstices.

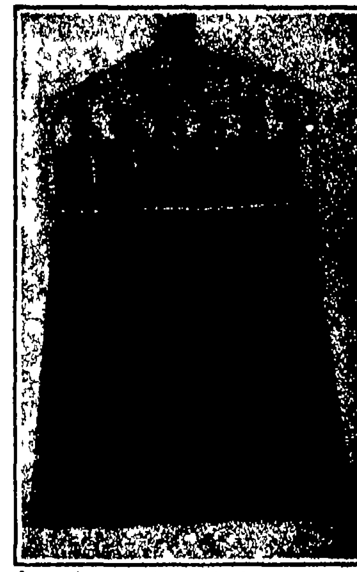
With silver one hundred and twenty thousandths of an inch thick no transparency is produced so long as the atmosphere is a "reducing" one, such as hydrogen or coal gas. But in the air the



Pie-plate statistical charts are turned out by this device while you wait

transparency begins at 240 degrees and is remarkably complete at 300 degrees.

Copper one seventy-five-thousandth of an inch thick does not become transparent in a reducing atmosphere, but in air it is transparent between about 200 degrees and 400 degrees.



Something different in house brooms

Steel Wire Brooms

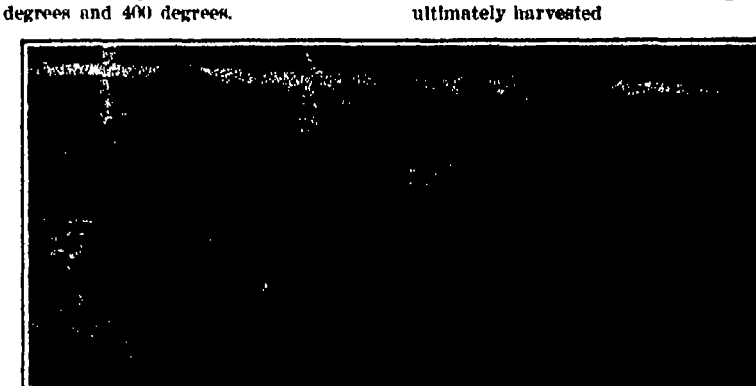
A STEEL wire broom is an efficient fire fighter and may be used for sweeping or spanking. It is not at all affected even by severe heat. The fillers, which are removable, will not spread fire, but will extinguish it. For brush and rubbish, it is also extremely useful and is employed in many fire departments for this purpose. If any of the fillers become worn or injured, they are easily replaced. The use of these brooms is, of course, not confined to fire work and they give excellent satisfaction in the garden or the plant.

Coloring Oranges With Oil Fumes

AN orange may be inwardly ripe when outwardly green and if allowed to yellow on the trees the marketing may be delayed four to six weeks and consequently a less favorable price may be obtained.

This green condition gives the Satsuma orange grower more concern than others. Satsumas are raised in upper Florida, lower Alabama and lower Mississippi. Normally they are gathered about October 15th, but they can be harvested earlier when artificial processes of coloring are used to get away from the persistent greenness of skin.

The United States Department of Agriculture has worked out a process for coloring oranges without harming the fruit. The process consists of enclosing the oranges in tight rooms and subjecting them to fumes of kerosene stoves or to gasoline engine exhaust. The fumes given off destroy the green chlorophyll so that the yellow of the orange shows up. It requires about four days to bring out the yellow of the oranges by this process. This is better than waiting four to six weeks for the fruit to ripen on the trees, running the risk of frost or storm damage and facing the probability of a lower market when the oranges are ultimately harvested.



Adapting the motorcycle to fire department service

Chassis suspension without an axle

Unique Chassis Suspension

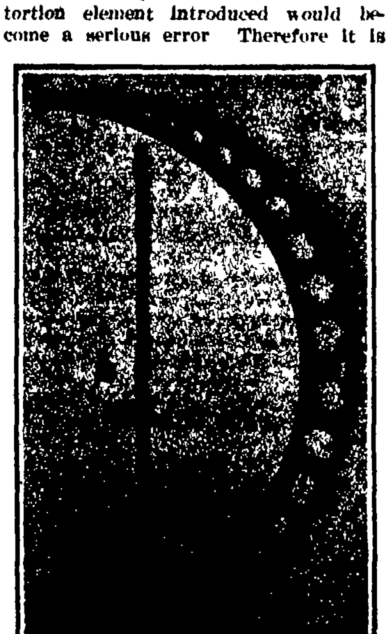
THE axle is entirely lacking in the new models of a well-known French motor car, and in its place is substituted a long transverse spring forming the lower member of a sort of truss, and a peculiar tubular piece for the upper member. This unique construction is employed both in the front and on the rear of the car, and it is stated that it has proved itself a remarkable success in service over rough roads.

The outer ends of the springs are attached by means of clips to the lower bearings of the steering pins. To the center of the spring is attached the upper central member. At the forward end of the car this is a tubular, obtuse-V construction whose outer ends are shaped like mallets lying on their sides. The heads of these "mallets" are concave, and contain shock absorbers which may readily be adjusted. The tie rods are connected by a universally jointed member to a transverse sliding member connected directly to the steering gear.

At the rear of the car the transverse leaf spring is bolted to the underside of the differential casing. The upper side of the differential casing is bolted to a tubular member which connects the sills of the chassis and extends past their rear ends far enough to take the same type of shock absorber and links used on the front of the car.

An All-Embracing Micrometer

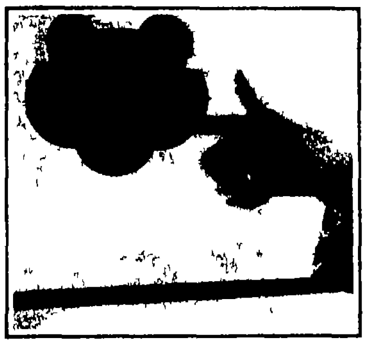
FOUR INCH micrometers are quite commonplace, but four-foot ones are not. The one illustrated on this page is one of the latter class and had to be built up as a special order. This micrometer weighs 32 pounds and a special pattern was required for casting the frame. The weight of this delicate instrument is so great that if it were used under ordinary circumstances the distortion element introduced would become a serious error. Therefore it is suspended from a special holding device which will also obviate errors caused by expansion due to the heat of the user's hands. The measuring spindle, barrel and thimble are standard parts from small sized micrometers, but the instrument itself which was made by a Providence, R. I., manufacturer, is quite unique in its span.



Specially constructed micrometer with span of four feet

A Vacuum-Held Glare Shield

MOST simple and practical is a glare shield held in place securely by the use of vacuum cups. By an arrangement of small hinges the green celluloid shield can be turned upward instantly. When needed to shield the eyes of the driver it is just as quickly turned down. The vacuum cups hold this shield so securely on the windshield that it can be removed only by inserting a knife blade between the cup and glass to let in a little air.



Cutting off the glare from the approaching car with a shield held in place by vacuum cups

More Room in the Suit Case

A DESIGNER of suit cases has provided a case for toilet accessories that fits into a compartment all its own at the back of the case. When removed from its place in a traveling case, it can be carried separately as it folds neatly into a smaller leather case as pictured in the illustration. The idea of space saving in traveling cases has also been incorporated in traveling bags for men or women.

New Motor-Wheel Doubles Usual Air Space

THE comfort of traveling in a motor car depends mainly upon the air capacity of the inner tube on the wheels. The more air the tube contains, the better it would be able to damp out all oscillations and shocks.

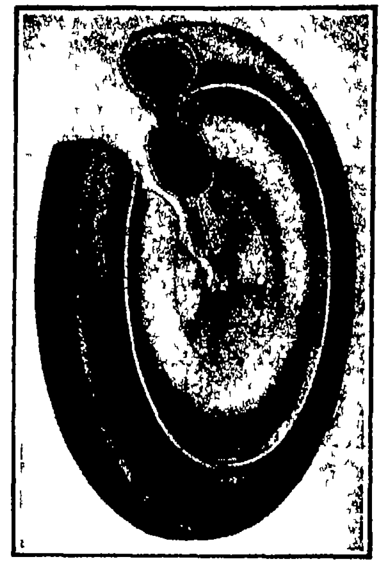
A British inventor has perfected a new motor wheel which has twice the usual air space; even light cars fitted with such wheels, it is stated, will travel as comfortably and hold the road as well as well sprung cars weighing two tons.

The new inner tube has a cross section like the Figure 8. The upper half of the tube lies inside the tire as usual while the lower one is accommodated within the disk wheel. Nine bolts hold the disk wheel together, and where they pass through the tube pieces of rubber have been vulcanized in, to take the bolt holes. In this way an absolutely air tight joint is assured.

To fit the tube to the tire, or to dismantle the tire and tube, tire levers etc. are no longer needed. By removing the nine nuts, the outer disk comes off and tube and tire can be taken out quite easily. The air valve projects through a hole in the disk wheel and is easily accessible. As the inner tube is no longer confined within the tire, but is partly in contact with the steel disk of the wheel, all heat generated in the tube, while the car is running is carried away by the cool air acting on the rotating disk wheel. A longer life of both tire and tube is in this way ensured. Owing to the great air capacity of the tube much thicker rubber walls can be used, making the tube more nearly puncture proof than it has been, and preventing sudden bursts.

Testing Gasoline with Molasses

IT has been discovered that molasses is extremely useful for detecting the presence of water in tanks of gasoline. Water is, of course, heavier than gasoline, and it will always sink to the bottom of the tank. In making the test a wooden stick is coated with molasses and this is pushed down into the suspected gasoline. The gasoline does not affect the layer of molasses in any way but, when water is encountered the coating comes away from the stick. Thus when the stick is withdrawn it is not only possible to see whether water is present but the actual amount is plainly shown by the height of the bare section at the bottom of the stick.



Putting more air under the car than has been possible heretofore

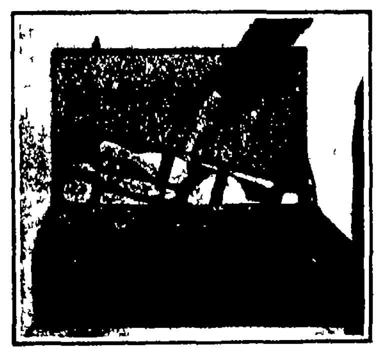
A Packing Case with Possibilities

A BOOM in the artificial kindling business is indicated by the appearance of a new packing box which is said to be indestructible.

In one week six hundred thousand American railway cars are loaded with what is called package freight, most of it inclosed in wood or wood substitute containers which after one train trip go into the furnace like Shadrach, Meshach and Abednego, but not like them to emerge unscathed. Between one-sixth and one-seventh of the total lumber production of the United States it is estimated meets this fiery fate after a career in the form of packing cases as brief as that of the silkworm without leaving behind it anything more valuable than ashes.

Conservationists have been working for years to reduce the mortality of our forests, in the new box it appears, they have found a powerful ally. The box, it is true, is made of wood but not of wood destined to a few weeks of work and then extinction; the wood that goes into this box has a long and honorable existence before it comparable to that of which a house is built and not limited to service in a single site. It can and probably will travel from coast to coast, from gulf to gulf to Punta Arenas, Kamchatka, Capetown, Calcutta, then full of years, it can regard the furnace as a crematory and its ashes worthy of preservation in an urn.

The Siamese twins High Cost of Living and High Cost of Distribution, inseparably joined, view the new box with alarm. Elimination of waste of lumber, saving of stowage space, prevention of pilferage, reduction of claims against carriers for loss and damage are included in the box's program. It has no nails for thieves to extract, no fragile panels to fracture and when it is returning from the commercial front or enjoying well earned rest it folds into almost insignificant dimensions, lowering its traveling and storage expenses to a minimum.

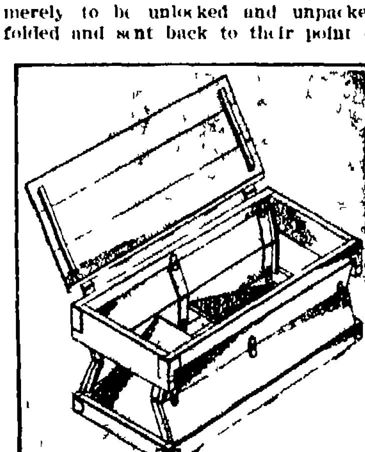


Making the toilet accessories take up less room in the suit case

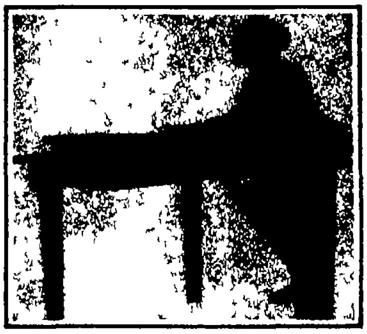
Like all strong things the box is simple. Made of unbreakable boards with rivetted hinges it can be contracted to one-eighth its service size instantaneously. One type now in use four and a half feet high folds to a height of six and a half inches and eight folding boxes can be stowed into space occupied by one non folding box. The size of box, however is not limited to four feet high. Pianos already are shipped in them and automobiles and cumbrous machinery can be.

The first cost of the box is larger of course, than that of a packing case intended to be used only once or twice but its cost divided by the number of possible trips becomes not much greater than a German mark or a Russian ruble. Some four and a half foot boxes have been used five years on one American railway, and seem to be good for another five.

Profitable as this box has proved in domestic commerce, its potentialities in international trade are even greater. Packing has been one of the worst of export problems. Loss in overseas shipments by breakage and theft has been in many instances the final handicap against American shippers in the keen competition which makes every cent count. Much money has been spent in perfecting pilferage proof cases for foreign trade with some success; these costly boxes represent an investment which must be recovered in one use. The new cases are not only pilfer proof but they do not have to be pulled apart to get the contents out when the shipment reaches its destination. They have merely to be unlocked and unpacked, folded and sent back to their point of



The indestructible packing case



Recently developed machine for cutting glass

origin to be utilized again and again They are proof also against the proverbial hostility of stevedores They can be thrown off a ship on to a concrete dock without breaking though that practice, in spite of its popularity abroad, is not advised

Americanizing the Ancient Chinese Game of Mah Jong

IT has remained for American inventive talent to simplify the fascinating Chinese game of Mah Jong, which has swept the country by storm Instead of utilizing the cumbersome and expensive Chinese tiles of bone and bamboo the Americanized version makes use of wafer like tiles simple striped sticks for the chips and neat racks to hold the tiles and to carry a simple table for figuring out the scores

The accompanying illustrations give a graphic description of the wafer like tiles invented by Mr Otis F Wood of New York City The tiles in this case consist of black and white sheets of celluloid cemented together the white side carrying the Chinese symbols of the game Because of their lightness and compactness the wafer like tiles may be readily handled and the game is materially speeded up Indeed, Mah Jong is now played for the sake of the game rather than for the pretty tiles

The racks of this Americanized Mah Jong are designed to hold the tiles at the proper angle Furthermore the front side is sloped so that the tile is guided to the slot by the hand of the player without his having to take his eyes off the game The chips' are little strips of celluloid with simple bands of black and red All in all this new game makes for greater concentration and better playing, so it is claimed by its inventor

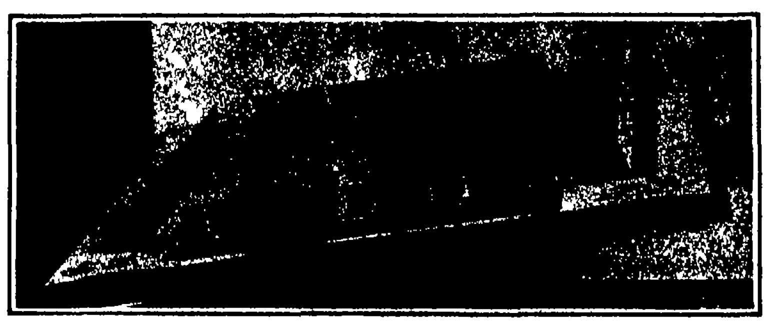
The wafer like tiles permit Mah Jong to be played anywhere—on the train on board ship in the home—everywhere When packed in an attractive box the entire game can be placed in a coat pocket Intentionally, one of our illustrations shows the game placed at an angle to indicate that the swaying motion of the train or the boat has no effect on the Americanized game of Mah Jong, with its wafer like tiles.

Cutting Glass with a Machine

LARGE mills sheets of glass have always been cut up into smaller sizes by hand, with much expenditure of time and with unsatisfactory results It has been necessary to score the glass with the cutter on one side and then break it under this treatment there is always the risk that the under unscored edge will crumble, or even that the whole sheet will crack The gaging has presented difficulties, too an allowance over the gage reading of from an eighth to a quarter inch having been necessary

A Newark manufacturer now offers a machine for cutting glass, based upon the new principle of scoring it on both sides This calls for two cutting arms two cutters and a spring held adjusting nut for insuring even pressure against both sides of the sheet as well as for separating the cutters for insertion and removal of the work. Breakage is eliminated as the sheet thus scored at identical lines on both sides comes apart at once and cleanly while the gage works to its true readings, without allowances Finally, it is claimed that owing to the better regulated and even pressure on them, the cutter wheels used on the machine have from five to ten times the life of those used by hand

Thick heavy Chinese tiles of bone and bamboo, compared to the American wafer like tiles



The Americanized version of Mah Jong played with wafer-like tiles and handy racks This game can be played anywhere, even in the swaying boat or train

Salt and pepper from a single shaker

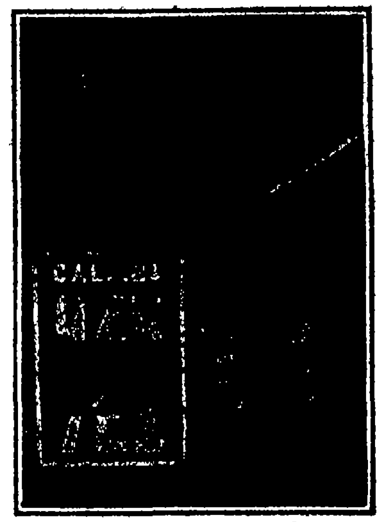
Half Pepper, Half Salt

THIS glass shaker for table use contains salt and pepper To the left of the notch is the pepper chamber to the right the salt. In the cap which is divided into two sections, are corresponding large and small holes One is closed while using the other A mix up is avoided when filling containers by the use of a paper cap which fits either side of the glass division In a picnic basket salt and pepper will not stray, but remain in the shaker

Marking the Stolen Car Beyond Mistake

THE advent of the automobile has built up an enormous field, previously non-existent for inventive ingenuity Certain simple needs of the motorist have yet to be met however, in spite of the amount of time and white paper that has been used up in trying to meet them One of the things that we have not yet seen is a really simple, really adequate, preventive of theft of the car Mr Jens Nelson of Los Angeles shows us, however an unusually clever attack upon this problem, and unlike the majority of clever inventions in this particular direction it is decidedly simple in operation and apparently, would certainly betray the fact that a car had been stolen, if it did not actually lead the thief to try his luck with another vehicle

Mr Nelson would build the license plate in two stories, with the first three digits (or less, or on some New York cars more) in the upper row and the last three in the bottom line He would thus have a sheet of metal large enough to enable him to cut out, from its center a circular or rectangular piece of such size that its absence would surely be noticed This removable piece would screw in by a simple thumb-screw device, and in this connection it ought to be pointed out that the difficulty of detaching a screw that has been in the plate for 365 days does not measure the ease with which the screw would come out if its removal were frequent We know lots of people who remove distributor arms, coil boxes, etc, from their cars when leaving them unattended we can't see why Mr Nelson's procedure isn't just as easy His only barrier, apparently, is the necessity of selling his idea to state licensing bodies rather than to the individual user



Theft-proof license plate—when you leave the car you take a piece of it with you

Specifications for Electrical Instruments

UNFORTUNATELY, national standard specifications have been better appreciated abroad than in the United States In the case of electrical measuring instruments, for instance, British specifications were adopted in 1909, French in 1921, and German in 1922

Realizing the benefits which would result from national specifications for electrical measuring instruments in the United States the Bureau of Standards has been striving to get consideration for the subject in this country It has translated the French and German specifications and sent copies of them, together with the British specifications, to American makers and large users of electrical instruments.

In cooperation with the Instruments and Measurements Committee of the American Institute of Electrical Engineers, a personal canvass of the instrument makers of America has been made. The results of this canvass show that a majority of the makers are in favor of standard specifications and indicate the desirability of having tentative specifications prepared to serve as the basis for further discussion Such a tentative specification was prepared and presented last June Further progress in the development of American standard specifications will be based on the comments and suggestions which will be received from instrument makers and users.

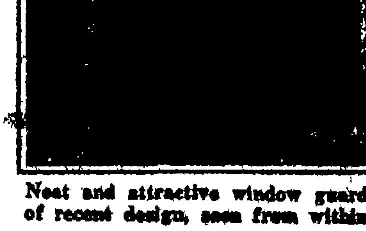
The Adjustment of Automobile Headlights

THE necessity for improved motor vehicle headlights is generally recognized and the Illuminating Engineering Society has developed satisfactory methods of test and has obtained a great deal of data on candle-power requirements and distribution These I E S specifications, as they are called, have been approved by the Society of Automotive Engineers for regulatory purposes. However even the best device obtainable will not be satisfactory to either driver or pedestrian unless properly adjusted

To help in educating the motoring public to the necessity and advantages of proper headlight adjustment, the Bureau of Standards has assigned an engineer to work principally on this one problem The Bureau intends to cooperate actively with all agencies interested in securing improvement in headlighting.

A Disappearing Window-Guard

AN interesting window-guard is offered for use with double-hung windows, to prevent ingress of marauders or egress of the baby while the lower sash is up. This guard is attached at the bottom rail to two rods extending upward through grooves in the side rails. It may be detached only from inside the window, by operation of a handle on the top rail It is so constructed and attached that when the lower sash is closed, the guard is carried down with it, into the space below the sill, and out of sight from without



Neat and attractive window guard of recent design, seen from within

The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals Other digests appear elsewhere in this issue

Automotive

Some Surprising Results were the outcome of tests made by a British motor truck operating company on a number of lubricating oils in service The tests were an effort to find out whether or not it is good policy to buy an expensive oil for commercial work. After the tests it was given out that the oil that cost the least and gave satisfactory results would be the best oil to use The method adopted for testing was straight use in a new or recently overhauled engine on a vehicle in ordinary everyday work. The engines were run for six months covering up to 24 000 miles Every effort was made to prevent setting up unusually ideal conditions for the tests—the oils were used as oils are used in commercial vehicles where ideal conditions are not usually attainable It was found that as a result of crankcase dilution, the oil viscosity generally drops during the first two months and then remains practically constant It is also stated that there was no necessary relation established between flash point and volatility An oil having a high evaporation value would be uneconomical in use The condition of the crankcase was found to be much cleaner when aluminum pistons were used as these keep cooler than cast iron and thus do not coke the oil on their under side Statements are frequently made to the effect that certain brands of oil owing to their superior friction reducing qualities, will enable a higher mileage to be covered per gallon of fuel From the records of the seven oils tested there would appear to be very little if anything in the argument for commercial work —*Automotive Ind*, 50 1 3 pp

The Epicyclic, Two-Speed Drive, similar in some respects to that used on the Ford car has been adapted to the stock models of a prominent German car The epicyclic gearing is brought into play by means of brake shoes which expand against one or other of two drums the braking effect being internal expanding instead of external contracting —*The Autocar*, 51 1465, 1p ill

Pink Gasoline may replace the water-white in use today if the public can be educated out of the whim for white 'gas " The idea is not exactly a novel one to the oil refiner for even now the gasoline exported to certain countries must be conspicuously colored also during the war the army and navy adopted a somewhat similar scheme for identifying the "fighting grade" of aviation fuel A predominating proportion of gasoline however, is refined water white simply because the great automobile-driving public has been taught to accept no other grade This is not the result of a deliberate educational campaign on the part of the petroleum industry rather it is a condition more or less forced on that industry by competition The public associates color with impurity, and the easiest way out for the oil industry was to call on the chemist and chemical engineer to take out the color The desired result has been attained remarkably well, even though the process has undoubtedly added something to the cost of the product and at the same time actually lessened its performance value In order to satisfy this whim of the public for water white gasoline, the petroleum refiner has consented to make the sacrifice —*Chem and Metall. Eng.*, 29 27

Last Year's Progress in Automotive Design as shown at the New York automobile show The new high turbulence type of combustion chamber is actually resulting in higher mean effective pressures The increased rapidity of combustion has resulted in materially advancing the peak of the expansion curve. Mean effective pressures of 100 pounds per square inch are becoming common in passenger car practice, and the high turbulence combustion chamber is responsible for this in no small degree. Nearly every new engine brought out during the past year has had this feature included in its design In all the new cars a real effort has been made to make the passages uniform between the carburetor and the cylinder Instead of easy bends and curves in the manifold, which tend to allow the globules in the mixture to segregate and deposit on the walls, square sections and abrupt turns are being used to agitate the mixture and thus to keep the fuel globules in suspension Turbulence in the manifold is regarded as important, just as it is in the combustion chamber, but for a different reason In the manifold it is to keep the charge in suspension, while in the combustion chamber it is to increase the rapidity of combustion Higher outputs without unreasonable compression ratios have been secured by a combination of better manifolding or distribution, better combustion-chamber shapes, reduced frictional horsepower, better balance, lighter reciprocating parts, larger valves, and a wealth of small refinements. The engines are more sightly because of the cleaning up of the exterior Finally, engines are much more durable because of greater bearing areas, the lighter stresses, and better materials —*Automotive Ind.*, 50 2, 3 pp, ill

Civil Engineering

An Experimental Rubber Pavement laid in Singapore has stood up in remarkable condition against heavy traffic The space used for the roadway test is 30 by 15 feet (50 square yards) and the paving was put down July 6, 1922 The blocks are 9 inches long, 3 inches wide, and 3¼ inches deep, and are formed of a hard basic compound with about three-eighths of an inch of rubber capping directly vulcanized on the three inch width of face, and without iron clamps or other mechanical attachments They are laid on a six inch concrete cement base and the test area is inclosed with granite blocks Up to the end of November 1923 it is estimated that fully 300,000 tons of loaded and unloaded motor lorries, wagons bullock carts and passenger automobiles passed over the rubber pavement, yet close examination revealed practically no wear In only a couple of spots was any movement of the surface remarked, and that was a trifling forward creeping, due probably to a slight pressure from the granite curbing Signs of slipping or skidding were lacking even though the pavement is subjected to fast and slow moving traffic, and heavily laden lorries and wagons pull up and restart upon it The roadway is exposed to the full rays of the sun and the rubber area has had no special treatment since being laid —*India Rubber World*, 69 4, ½ p.

The Building of a Railroad Across the Sahara has been approved by the French government and the only thing that now stands in the way of the actual accomplishment of the project is the formulation of a law by the chamber of deputies It is expected that building of the trans-Saharan railroad will take seven or eight years It will connect Oran in French Morocco, with Wagadugu, capital of the province of High Volta, near the Gold Coast. Stretching from the Mediterranean to the Niger, passing directly across the immense wastes of the hitherto unconquered deserts, the trans Saharan line will be an achievement almost as important as the trans Siberian road. Not only will it be a work of great strategic importance, by linking up two widely separated parts of French West Africa, but it also will be of vast economic value, facilitating the transportation of exports to Marseilles. An interesting feature of the proposed trans-Saharan railroad is that for the most of the distance of 1750 miles it will be necessary to run pipe lines or maintain a conduit system of some sort, connecting with deep artesian wells, to insure an ever available water supply France will gain direct and easy access to a realm in west central Africa with riches hardly touched at present.

(*Continued on page 188*)

Then, a tug of war — now, a "reel" job

HEAVE, HO! In the old days, from eight to sixteen men were needed in the factory to pull a single telephone cable core into lead pipes—which, soldered together, formed the sheath. A slow and laborious task.

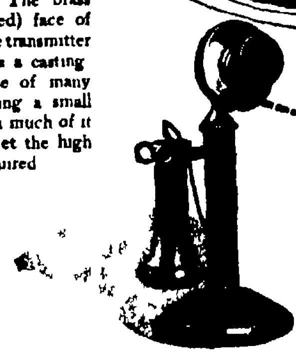
THE pictures show the old and the new way, as applied to two manufacturing processes of many thousands in our factory.

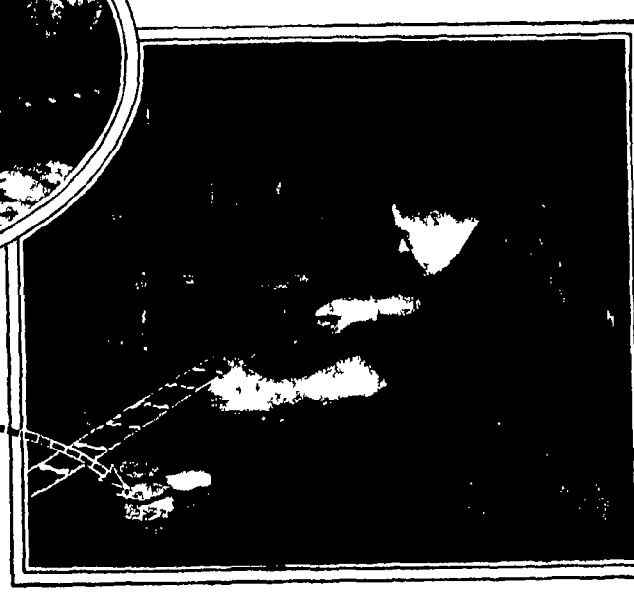
Better work, quicker work, and yet with fewer men needed for each job—progress like this marks the history of Western Electric as a maker of telephones.

Improvements of this kind have made possible lower costs of manufacture and vastly increased production, and here you have two reasons for the vast number of telephones in the United States—more than in all the rest of the world.

HOW IT'S DONE TODAY. Now two men can operate the machinery which applies molten lead to the cable core to form a continuous covering. These two men cover more cable than the sixteen did the old way—and what's more, they do it better.

MOLDING TRANSMITTER FACES the old way. The brass (nickel-plated) face of the telephone transmitter was made as a casting. Another case of many men producing a small output—with much of it failing to meet the high standard required.





THE TRANSMITTER FACE TODAY. Now it is punched out of a brass strip. One man produces more than the crew of yesterday, and with a far higher percentage of perfect pieces.

Western Electric

SINCE 1869 MAKERS OF ELECTRICAL EQUIPMENT

Scientific American Digest

(Continued from page 186)

The ministry of colonies foresees the possibility of converting a dry but fertile area of approximately three-quarter million square miles into fruitful regions, ranking with the valleys of the Nile or the Euphrates This vast extent of virgin land is looked upon as a potential granary for France making her, with the aid of her colonies self sufficient in all respects Three problems face the railroad companies to be formed One is the menace of bandits, which the government believes can be easily solved The second and third difficulties are sand storms and torrential rains which occur at regular periods —*Railway Rev*

Regenerative Braking Tests of an electric locomotive were made at Erie, Pa, for the Mexican Railway The electric was pulled by a mikado type steam locomotive, equipped with booster, superheater and all other improvements, and operated by a picked crew During this test the electric locomotive, connected to send power back to the line was hauled by the steam unit at a speed of about 14 miles per hour, the steam unit operating at full capacity As high as 1800 horsepower was sent back into the electrical system at one part of the test —*Railway Rev*, 73 24 1 p

Saving a Concrete Road —A method of resurfacing concrete roads which have become worn by constant and heavy traffic, and which may claim the attention of engineers, is described in *Mfrs Record* In 1918 the road from Humble to Moonshine Hill in the heart of the Humble Oil Field Texas, was paved with concrete This road is subjected to the usual heavy oil field traffic and by the summer of 1920 showed such rapid wear that the county commissioners decided that it was necessary to resurface the road immediately Sufficient funds to apply a two inch hot mix bituminous surface were not available and it was necessary to lay something cheaper Inverted penetration using trap rock and Texaco No 250 asphalt was selected The road was swept clean and one half gallon of asphalt per square yard was applied with a pressure distributor The asphalt used is a very soft grade, having a penetration of 250 to 300 at 77 degrees Fahrenheit It adheres to concrete perfectly especially when the surface has been roughened by traffic The asphalt while still hot, was covered with trap rock one inch to one-quarter inch in size a cubic yard of stone covering approximately forty five square yards The surface was then rolled lightly to set the stone in the asphalt and immediately open to traffic. The road has been subjected to very heavy traffic for three years since this surfacing was applied and now is in excellent condition, as is clearly shown by a photograph taken three years after the completion of the surfacing job The surfacing has adhered to the concrete perfectly and there has been no sign of shoving, rolling or rutting This method of resurfacing a concrete road is recommended where sufficient funds for laying a hot mix bituminous surface are not available.

Electrical

Centralized Combustion Control has been developed to govern boiler plant operation electrically In one system described in *Power* (59 2), as applied to stoker fired boilers, the forced draft fans, stokers and induced-draft fans are driven with direct current motors. The speed of these motors is controlled by an exciter motor generator set, the voltage of which is adjusted from a master regulator which gives the initial impulse If an increased load is thrown on the turbine this will cause an increased demand for steam and a drop in the steam pressure, which will cause the master regulator to operate and move in a direction to cut resistance into the field circuits of the exciter generators, thus causing the voltage of these machines to be reduced The reduced voltage applied to the field of the stoker and fan motors weakens their field and causes them to speed up to supply the proper amount of fuel and air to carry the new load On the other hand, a reduced load on the turbine causes opposite effects. Thus the master regulator causes the whole boiler plant to respond automatically to the load.

The Inter-Scandinavian Power Project has been reported on by a commission appointed by the governments of Denmark, Sweden and Norway It is believed that within ten or fifteen years the power demand in Denmark will probably reach 500,000 kilowatt hours a year Power would be transmitted directly from Norway to Denmark through an 80-mile cable in Skagerack. The plan calls for three single-conductor cables, each insulated for 110,000 volts to sheath One of these would be a reserve cable, although normally running in parallel with one of the others If three-phase transmission were used from Norway to Denmark, a 132 000-volt line would be erected along the Swedish coast down to Helsingborg, on the Straits of Oresund Since at present cables cannot be operated safely above 50 000 volts, it would be necessary to step down to this voltage before crossing to Denmark. An alternate scheme therefore has been worked out, calling for an aerial crossing 200 feet high as a minimum over the Straits. Two spans would be needed, each 7500 feet long and carried on 650-foot high steel towers The conductors would be 240 square millimeters (475,000 circular miles) extra high-quality steel. —*Elect World*, 82 19, 2 pp, ill.

Forty Lighting Intensities in One Street is the experimental answer given in tangible form by the city of Cleveland to the unsettled question as to how much light and how disposed constitutes good street lighting Forty separate lamp circuits were set up in a 2000-foot section of a typical Cleveland street, each circuit illustrating a definite principle of correct illumination In a lighting sense, this constitutes virtually 40 streets in one Lamps ranging from 100 candlepower to 3000 candlepower in size, with spacings from 75 feet to 900 feet are mounted at heights from 11 feet to 26 feet. The location of the units ranges by four successive steps, from two feet back of the curb line to the center of the street, bracket arms being used This is the only place in the world where an instant comparison of a wide variety of lighting effects upon the streets can be made One purpose of this unique installation is to afford a ready means for study of lighting effects under a variety of conditions with a view to obtaining some clear, definite information on the value of each system Another use, how ever, is brought out when a town or village wishes to select a suitable street lighting system Generally this has had to be done without proper opportunity to study the actual installations in the very comparative sense afforded only by having them all set up in a single street and being able to shift from one to the other and back again within so short a space of time that a really accurate comparison can be made and the large element of personal equation heretofore existent, practically eliminated —*Elect World*, 82 22, 1 p ill

The Factory of the Ford Motor Co. at Green Island, N Y is heated by hot water which is heated by electricity The building is 1140 feet long, 120 feet wide and consists of three bays the two side bays being about 20 feet in height and the central bay about 35 feet in height. The outer exposure of this building consists of about 60 per cent of glass 65,000 square feet of radiation is installed Water is circulated by motor-driven centrifugal pumps at the rate of 1500 gallons per minute at a pressure of about 40 pounds. The water is circulated through one or two electric heaters, depending upon weather conditions, and is raised to temperature from 135 to about 158 degrees Fahrenheit. The heaters are of the electrode or water-resistance type, having a capacity of 8200 kilowatts each, and are operated at 4600 volts three-phase 60 cycles. The advantages of electric heating are cleanliness, minimum of space required and high efficiency No separate heating plant is required, no fuel storage, ash handling or labor The heaters require only occasional attention by a janitor or other attendant.—*Power*, 59 2, ½ page, ill

London, as well as most of the cities of Great Britain, is almost entirely lighted by gas, according to a writer in *Electrical World* (82 21), and excellent gas lighting it is. The one drawback to the wider and more intensive use of electricity there is the lack of standardization The Britisher recognizes that there should be regularity in the sizes of hats, collars, screws and nuts, but when it comes to the voltage and frequency of his electric supply, he has thus far evinced no interest. Confronted with almost as many varieties as a dog has fleas, the manufacturer is also in a dilemma. Big production is out of the question, distribution of supplies is difficult stocks are as numerous as the stars, so that costs must necessarily be higher In the area of Greater London alone there are some 70 generating stations, representing between them 50 dif-

ferent systems of supply, 24 different voltages and 10 different frequencies The average price of current in 14 London municipally owned plants varies from 3 80 to 10 58 cents per kilowatt hour 14 private plants in the same city receive payment at from 3 04 to 11 9 cents.

General

The Inability of the German Steel Industry to Reenter World Markets on its former scale in the near future will be particularly marked if the French in order to provide reparation funds or for other purposes decide to enforce special export or import duties coal taxes or other forms of taxation in industry and if the existing customs barrier between occupied and unoccupied Germany is continued The coal coke and metallurgical production of the Ruhr and the finishing industries and food providing regions of unoccupied Germany the commercial attaché pointed out constitute a natural economic unit whose sudden separation is likely to mean depression higher production costs and general inefficiency At one time it was believed that the long cessation of steel exports from the Ruhr due to the embargo and other incidents of the occupation, would result in heavy dumping when passive resistance was abandoned and in embarrassment to our own export trade Long before passive resistance was given up it became apparent however, that the great reduction in normal output due to transport paralysis and other causes, and the volume of prior orders which could not be filled after the embargo became effective in January of this year, would greatly limit the stocks available for dumping abroad The possibility of dumping and breaking world prices has been further discounted by the lien which the occupation authorities have maintained on finished steel stocks pending the settlement of tax coal delivery and other questions—*Iron Age*, 112 25, ½ p

The Old Style of Balloon Shaped Carboy packed in hay, formerly used for shipping acids has passed out of existence according to a manufacturer of chemical glassware In its place we have the straight side carboy cushioned within the box entirely with wood This change was necessitated on account of the excessive breaking with the old style carboy and frequent fires arising from nitric acid coming into contact with combustible packing material The straight side carboy is much stronger than the balloon shape and can be more readily cushioned with wooden braces There have been several designs of carboy cushioning used in recent years but the severe tests to which they must be subjected to meet the specifications of the Bureau of Explosives has eliminated most of them The severity of these tests will be appreciated when it is explained that one test, called the drop test requires the carboy to be filled with water and then dropped from a height of 16 inches squarely onto a concrete floor without breaking The other test called the swing test requires the carboy filled with water to be suspended from a point 14 feet high and allowed to swing squarely against a solid concrete wall from a horizontal distance of 55 inches without breaking—*Brass World*

Another German Invasion of the Chemical Industries is anticipated by *Chem and Metall Eng* (Vol 29 No 25) in an editorial in which it is stated that the fall of Stresemann if we can place reliance on reports that come to us from Germany may prove to be the signal for the German chemical manufacturers to abandon all hope of continuing their operations in Germany This does not mean that all chemical activities will be transplanted, lock stock and barrel, to other countries It does mean in the opinion of experienced observers the beginning of the migration Ever since the armistice delegations of German traders and financial men have been visiting this country Lately some of the foremost of the German industry's technical experts have been inspecting our centers of chemical industry, as well as our water power developments Sometimes the missions of these men have been satisfactorily explained at other times suspicion might easily be attached to their movements. At any event it is not likely that negotiations for the purchase of plants in this country or the establishing of manufacturing subsidiaries will be made known to the general public Such a procedure is not in keeping with methods used by the German industry in this country prior to the war, nor with those that have resulted in the German control of various French and Italian chemical industries.

Rather the invasion would be of the nature of a peaceful penetration. By buying into some of the weaker chemical plants and gradually expanding operations it would be entirely possible for the Germans to obtain a strong foothold in this country before it would become generally known even to those in closest touch with the industry"

Shooting Oil Wells is now comparatively safe In the past, liquid nitroglycerin was the explosive most commonly used for this purpose Because of its extreme sensitiveness to friction impact, and heat, it is easily exploded This, since it permits a simple method of detonation, is desirable for oil well shooting but its sensitiveness also makes liquid nitroglycerin an extremely dangerous explosive to handle and each year it exacts a large toll in lives Of late there has been developed a type of high grade gelatin which is particularly adapted for deep-well shooting Results equal in every respect to those secured with liquid nitroglycerin can now be obtained with *torpedo gelatin* a product that is plastic and can be readily and firmly packed into the torpedo shells Torpedo gelatin is an explosive and of course must be treated as such one should always remember that its purpose is to explode It is however much safer to handle than liquid nitroglycerin and it may be transported by any public carrier in accordance with I C C regulations —*Explosives Eng*, 1 8.

Smuggling has become a regular business. It has reached a point where boats engaged in that activity have arranged for return cargoes Tobacco and other commodities subject to import duties and excise taxes in other countries are carried back and in turn are smuggled into those markets The smuggling began as a side line in connection with the illicit traffic in alcoholic beverages It is still being conducted in connection with liquor running, but the side line has become a much more important part of the undertaking In many instances it is known to be more profitable to import certain concentrated chemicals and special pharmaceuticals than it is to bring in whiskey The rum runners have blazed the path for a renewal of smuggling operations of a general character on a wide scale, according to customs officials in Washington and a number of smugglers find it more profitable to handle drugs and chemicals jewelry and fine laces than to handle whiskey —*Chem and Metall Eng*, 29 27, note

Industrial Progress

Methods by Which Enormous Volumes of gasoline now lost in ordinary petroleum refining processes may be recovered by the condensation of still vapors are outlined in detail by the Bureau of Mines in Technical Paper 310 At 13 refineries from which data were collected 128,051 gallons of gasoline representing an average increased recovery of nearly half a gallon of gasoline per barrel of crude oil were being recovered daily from uncondensed vapors. The figures represent the increased conversion into gasoline of 1 05 per cent of the crude oil charged, which would otherwise have been lost Losses of gasoline from uncondensed still vapors will tend to become larger in the future the Bureau of Mines points out, because the growing tendency to eliminate evaporation losses in handling crude oil in the field will result in refineries receiving crudes containing much lighter and more volatile fractions The magnitude of the losses resulting from non condensation of still vapors has been realized by only a small proportion of the refiners and comparatively few plants have installed recovery systems.

A New Instrument for Showing the True Body of Oils has been developed When an oil is rated by the time it takes for a given quantity to flow through an orifice under the influence of a gravity head, the density of the oil at the temperature of testing has considerable influence upon the result so that when the oil is diluted by gasoline as is usually the case, and the weight of a unit volume is less, an error is introduced The new instrument is of the cup and ball type and the viscosity measurement depends upon the time taken for a very small quantity of oil to flow between the cup and a steel ball which is initially pressed into the cup The whole apparatus is preferably immersed in a bath of the oil to be tested a thermometer is inserted in the handle of the cup and the temperature is raised When equilibrium is reached at, say, 210 degrees Fahrenheit, the ball lying at the bottom of the bath, the cup is pressed over it, care being taken that no air is en

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The Force that Builds, Equips and Operates

WESTINGHOUSE ELECTRIC

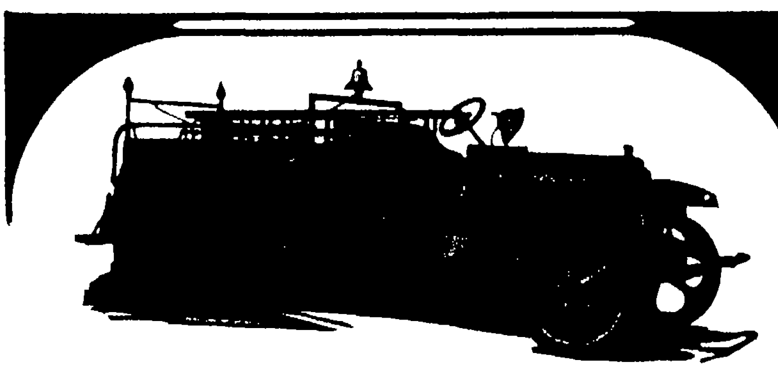
ONE may not think that electricity plays a big part in the erection of a building, yet the extent to which it helps construction work is remarkable

In the production and fabrication of materials that go into a building, in the tools, appliances and machinery used in its construction, in a great part of the equipment necessary for its use as a business or industrial establishment, in the power that keeps all this equipment operating day after day—in all phases of building, equipping and operation, you'll find the same generation and transmission of power that is back of so many human activities

Westinghouse has played an important part in this development at every step Apparatus that generates the electricity, apparatus that transmits it, apparatus used in utilizing it—even the principle of *alternating current* which, to a large extent, makes possible the use of this apparatus—are part of the Westinghouse contribution to mankind.

WESTINGHOUSE ELECTRIC MANUFACTURING CO.
Offices in all Principal Cities *Representatives Everywhere*

Westinghouse



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trapped. The handle of the cup is then raised, carrying the ball just clear of the bottom of the bath, and the time is noted by a stop watch The ball will drop as soon as a film of oil has crept between it and the cup, and the time taken for this action, in seconds, divided by a constant, gives the actual value of the body of the oil—*Automotive Ind*, 49 25 2 pp, ill

Using the Waste Heat in Coke.—In all gas works the output of gas results in the production of coke, which leaves the retorts in an incandescent condition The heat in the coke has invariably been wasted but efforts have been repeatedly made to utilize a considerable portion of it It would be a great achievement if the whole of the heat could be used it would be available, for instance, for heating water for industries requiring hot water daily, the year around such as large laundries It has been hitherto the usual practice to quench this incandescent coke with sprays of water, resulting as is well known, in a loss of approximately 630 British thermal units of potential heat per pound of coke cooled Means have recently been devised for obviating the tremendous waste of potential heat and from results which have been yielded by a test plant built on an industrial scale it has been shown quite definitely that a quantity of from 800 pounds to 900 pounds of steam at 100 pounds per square inch pressure can be produced per ton of incandescent coke cooled The most recent advance has been made in Europe, where incandescent coke is now cooled in several ways on a large scale An experimental plant has been constructed in a Swiss gas works The results obtained have been considered so satisfactory that a number of other similar plants are being installed and more are under consideration—*Am Gas Jour*, 119 28 1 p

A New Foundry Wrinkle—The foundry is pushing its neighbor the machine shop, close in the manner it is adapting compressed air equipment to its various activities. A new use for air has been found at a Cleveland plant where it is employed to remove the cores from automobile cylinder castings. The shakeout machine in effect is a combined vise and vibrator The vise holds the casting and the vibrator agitates it to such an extent that all the core sand disintegrates and runs through the opening in the crankcase through the opening between the two side members of the machine and on to the conveyor leading to the waste sand disposal tank The molding sand adhering to the outside of the casting is dislodged at the same time and falls on to the same conveyor The frame of the machine is a one piece steel casting and is bolted to anchor bolts in the floor It is provided on the upper or working side with the following features Two powerful coil steel springs to absorb the shock while the vibrator is in action a suitable frame bolted to the frame to support the weight of the casting a combined ram and vibrator which pushes the casting hard against the coil springs and then shakes the sand out of it an air cylinder which operates the plunger attached to the combined ram and vibrator Approximately six seconds is sufficient to remove all the core sand from a cylinder block.—*The Foundry*, 51 24, 2 pp, ill

A New Cupola Which Preheats the Blast.—It has remained for European practice to take the lead in the use of this principle in the common cupola furnace The type of cupola invented by E Schurmann Dresden Germany, is the first to be used in this country This furnace was completed and placed in service early in October, and has been in continuous service since that time The advantage claimed for the cupola in practice are the saving in coke, a reduction in the sulfur content and a greater toughness in the iron melted The user states that the test pieces poured from metal melted in this cupola are much tougher than those from the standard type cupola A saving of from 20 to 25 per cent in the amount of coke required to melt a given quantity of iron is reported The sulfur is said to be about two points lower in the iron when it comes from the cupola than when it was charged The analysis of the entering charge shows 0 175 per cent sulfur It is said the metal shows a sulfur content of 0 155 per cent when the metal is taken from the cupola. The melting speed of the Schuermann cupola is about 60 to 70 per cent of another cupola the same size in use in the foundry in which the initial American installation was made—*The Foundry*, 51 24, 3 pp., ill

A Process for Fixing Free Nitrogen is being perfected by the Fixed Nitrogen Laboratory of the Department of Agriculture, according to the annual report of its director One of the most important steps in any process is the development of a catalyser whose purpose is to aid in the chemical reaction which takes place when hydrogen under pressure is combined with the nitrogen of the atmosphere to form ammonia. In this latter compound nitrogen is available for fertilizers Of the several processes which have been used successfully on a commercial basis the direct synthetic ammonia process is apparently the most promising one The problem involved in the synthetic ammonia process may be divided into two groups, first those which concern the process of making the hydrogen combine with the nitrogen of the air and, second those which concern the process for manufacturing and purifying the hydrogen nitrogen mixture employed in the process The nature of the entire process centers about the catalyst, and depends largely upon its characteristics. As far as we have been able to learn, there is no country in the world which has an ammonia catalyst superior to that developed by this laboratory A method has also been developed for manufacturing this material which gives the necessary chemical control of the product and at the same time makes large scale production possible As a consequence we are now in possession of such reliable information concerning at least one type of ammonia catalyst and its manufacture that one of the principal obstacles to the successful operation of such plants as United States nitrate plant No 1 at Sheffield, Ala, has been removed

The Instrument Field has been active in its contribution to power plant progress during the past year A new steam flow meter correcting automatically for variations in steam pressure and temperature has made its appearance, other meters for the measurement of steam have been improved and simplified, and new combinations to give other data on the same chart effected Among the new developments may be mentioned a combination barometer and vacuum recorder, a hand tachometer fitted with speed recording mechanism three new electrical CO_2 meters making use of the variation in thermal conductivity of the flue gases draft gages of the dial type readable across the boiler room, an instrument for indicating and recording variations in the water level in a boiler under pressure and a variety of other devices, all designed to give the operator some specific information and help him visualize the actual operating conditions —*Power*, 59 1, 4 pp ill

Salt Made from Sea Water is the product of a large California industry The sea water is taken from San Francisco Bay during periods of maximum high tide in May, June, July, August September and October The sea water enters the works generally through a slough into the intake receiving or tide pond which is provided with large flood gates that automatically open when the water can run in and close as the tide ebbs. From the intake pond the sea water is raised by a large paddle-wheel pump and goes through the ponds mentioned gradually becoming more and more concentrated until it reaches the crystallizing ponds It is run into these to a depth of about six inches when it has reached a strength of about 25 5 degrees Baumé or when crystals of salt begin to form The industry is on a sound basis, although competition has been keen among producers, conditions are better than they are on the Atlantic coast, where large consignments of salt arrive at irregular intervals from Europe and tend to upset the market. Furthermore the climatic conditions in those parts of California where the so-called solar evaporation methods are practiced are fairly regular little or no rain falls between March and October The total evaporation during a season from March and through October, aggregates about 30 inches Harvesting commences about the middle of July when five to eight inches of salt is found —*Chem and Metall. Eng*, 29 26 3½ pp, ill.

A New Source of High-Grade Coking Coal will be made available by the discovery of a process for separating small amounts of pure coal from large masses that are impure The specific gravity of each piece of coal depends upon the quantity of ash present in that piece Hence if a separation be made by a "float and sink" method by introducing the coal into a liquid of the desired specific gravity, as for example 1 38, all the coal having a specific gravity less than 1.38 will float and all the coal having

a specific gravity greater than 1.38 will sink, and an exact separation will thus be made, dividing the coal into two definite grades, the low ash grade having less than six per cent ash This process consists in the production of a heavy gravity liquid, termed a 'fluid mass, by agitating a definite mixture of any suitable comminuted solid, such as sand, and water the sand being kept in suspension in the water by suitable means for providing agitation and the mix readily maintained at any desired specific gravity The specific gravity is under close control and can be varied accurately at will In the anthracite region of Pennsylvania this process has also been used since two years to prepare the coal for market by the removal of slate, etc. one machine doing the work of a large number of the usual jigs spirals and other slate removers.—*Iron Age*, 112.26, 2 pp ill

A Remarkable Improvement in Hack-Saw Blades *has been accomplished by an* English manufacturer, which, when used in conjunction with a special machine gives six to ten times the usual output per blade The new blade can be resharpened It contains 18 per cent of tungsten and it is claimed that it cuts progressively faster and faster after each resharpening Tests made on the new blades bore out the manufacturer s conservative claims A long series of cuts were made from a four inch mild steel bar, using a 12 inch blade 1¼ inches wide with six teeth per inch, running at 170 r p m. While the successive cuts required a longer and longer period of time up to about thirty when the blade was resharpened it was found that the time needed to make the corresponding cut of each series was shorter and shorter *within each series*. That is the saw actually improved with use provided it was resharpened The 282d cut was made in 4¾ minutes—less than any preceding one The average time was seven minutes per cut. In general these blades appear to cut the time required for the present practice about in half, while the output per blade is increased 7 4 times —*Brass World*, 19 12 2 pp, ill

New Interest in an Old Coalfield in North Carolina—Believing that the Triassic coal of the Deep River field was much more valuable than had been generally considered and that it should become a source of fuel, not only for mills and railroads of Eastern North Carolina, but for domestic use in the form of coke a geologic investigation was made of this field during 1921 and 1922, by the North Carolina Geological and Economic Survey and the United States Geological Survey Coal deposits have been known in North Carolina for about 150 years and for many years there has been more or less interest aroused as to the possibility of developing commercial fields of this mineral Considerable prospecting and some mining has been done during this period, but most of the work was a failure due to several causes, chief of which perhaps was lack of capital and having men unfamiliar with coal mining in charge of operations. As a result the public began to consider that either the coal was so poor or the mining conditions so bad that it was very doubtful if coal mining could ever be made to pay This was probably a natural sequence considering what was known of some of the coal which was in very thin seams and obviously could not be worked profitably Also considerable coal that was first used was weathered and did not have the heating properties expected of it. The amount of available coal in this workable field referred to above is estimated by the geologists as approximately 68 000,000 tons of recoverable coal and that mining can be carried on profitably to a depth of 2000 feet. The area in which this tonnage is included is about 25 square miles, and it is considered reasonable to assume that the coal bed throughout this area averages at least three feet in thickness of recoverable coal.—*Mfrs Record*, 84.26, 2 pp.

The Year's Contribution to Power-Plant Progress.—During last year all sorts of facts, theories and ideas that have for years lain dormant in textbooks have come to life, demanding immediate recognition Remarkable openmindedness has been exhibited by the engineering profession toward these "innovations." Whether it be 1200-pound steam pressure, the mercury turbine or reheating between turbine stages, every suggestion of theoretical merit is being given serious attention A number of the largest and most recent central-station plants are being equipped to burn pulverized fuel, steel plants are patterning after the River Rouge installation of the Ford com-

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pany and are equipping to burn in combination powdered fuel and blast furnace gas, a variety of smaller industrial plants have adopted this method of burning coal, and a surprising number of existing plants are trying out one or two boilers with this fuel to determine the system that will fit in best with their particular conditions One large central station that has been burning fuel oil for several years is trying out powdered coal under one or two boilers. Overproduction due to the ever increasing demand for gasoline vast quantities of oil in storage and low prices, summarize the situation in the oil field The last named factor has stimulated the use of this temporarily cheap fuel in the boiler room and has resulted in numerous changes with profit from coal to oil. Not alone in New England is oil fuel making great headway, but a considerable number of new buildings in New York City as well as in Philadelphia and other sections are adopting it Its use for heating boilers is also increasing —*Power*, 59 1, 4 pp. ill

Breaking Up Large Castings by means of explosives has been hastened by a new and interesting method used in England for boring holes for the explosive charge A long piece of one-fourth inch external diameter iron pipe is connected to a cylinder of oxygen by means of a flexible tube The end of the pipe is then heated to a red heat, when the oxygen is slowly turned on The metal of the pipe is thereby ignited and continues to burn at great heat This flaming metal torch is then used to melt a hole in the casting, being simply pushed into it like a hot knife into butter It was found that a 14 inch length of the small pipe was sufficient to make a one inch hole three and one half feet deep in a casting in this manner The hole is continually kept free from molten metal by the pressure from the cylinder of oxygen Heavy masses of concrete may be attacked in the same manner —*Practical Eng* 68 1920

Two Developments which seem to be increasing in favor and usefulness are the development of the centrifugal casting of metals, particularly of tube and ring forms, which seems to offer much promise both in economy of cost and increase of quality and the increased use of chill molds in the production of castings which have to be duplicated a large number of times and in particular the increased use of pressure die castings Chill castings are now being produced in brass and bronze and pressure die castings of intricate form in lead tin zinc and aluminum base alloys Only the lack of a satisfactory mold material prevents the possibility of producing pressure die castings in brass and bronze which could thus be cast to size and require little or no machining —*Brass World*, 19 12 ¼ p

Metallurgy

Ford Will Make Steel in New Way.—Direct production of steel from iron ore in one continuous process has long been a dream of metallurgists Something over two years ago a considerable stir was caused in European steel circles by the announcement that a French metallurgist, Basset had developed such a process and that a company had been formed to work it on a large scale Reductions in the cost of plant, fuel and labor were claimed and the over all cost of production was said to be only 50 per cent that of the standard method Critics of some competence held these claims exaggerated however The Basset system is not the only one of its kind, however and the Ford Motor Co will test at its River Rouge plant the Bourcoud process for the direct production of steel This process involves four separate stages. As in the Basset process powdered fuel is used and the first stage consists of the gasification of this fuel In the second stage the iron ore is reduced by the gases thus formed, the iron sponge produced is charged into an electric furnace and the slag removed in the third stage, while in the fourth the steel is further refined if necessary The material thus never gets cold from the time the ore is first heated, hence there should be a saving in fuel Waste heat, moreover is expected to furnish all of the power required for working the process —*Automotive Ind*, 50 1

The Superiority of American Duralumin.—An interesting commentary appears in an editorial in *Chem and Metall. Eng* The greater experience of Germany in the alloy field of metallurgy, and the German's reputation for painstaking accuracy and carefulness have probably been responsible for the prevailing idea that no aluminum alloys have yet been made quite equal to the German The impression has been dispelled, however, by a recent incident from which we learn that the German product has been far outstripped by the American, particularly with respect to that most important single factor—uniformity It appears that Commander Weyerbacher, builder of the navy dirigible "Shenandoah" has stated in a conversation and in an unofficial manner, that American duralumin is uniformly dependable, while that produced in Germany is sometimes excellent and sometimes "not so good"

Tying Gray or White Cast Iron in Knots is now made possible by a new process invented by Alex K Schlaap The process is very simple, consisting in heating the cast iron to a temperature shortly above the critical temperature of 1600 Fahrenheit, while protecting it in a muffle surrounded by a gas flame and open at the top As soon as the gray cast iron reaches the proper temperature the muffle and its contents are removed from the furnace and allowed to cool in the open air The whole operation requires about 45 minutes, starting from cold cast iron The method has been in continuous use for a year, chiefly for the purpose of softening gray iron castings for machining purposes, and especially for making automobile piston rings The most noteworthy characteristic, is the combination of pliability, ductility, malleability and resiliency In its resiliency the heat treated metal most resembles steel, since it shows this property both before and after distortion For example, a thin bar might be coiled up into a spiral and used as a spring, although of course, not nearly as strong and resilient as a tempered steel spring It is worthy of note that this annealed cast iron does not warp on standing Samples of annealed iron have stood for several months without changing shape by as much as one thousandth of an inch, as compared with unannealed castings of the same metal and pattern, which have warped —*Iron Age*, 113 1, 7 pp, ill

The Effect of Titanium Additions in open hearth steel treated with ferrosilicon as a deoxidiser is the subject of investigations made by the Bureau of Standards described in Tech Paper 241 It was found that a higher percentage of piped rails come from titanium than from silicon treated rails, but the time of teeming affects the number of pipes The greatest number of pipes were in rails from steel treated with the smaller amount of ferrocarbon titanium per ton and variations in the amount above this did not seem to affect the pipe The titanium treated rails were harder to break and showed more uniform fractures in the drop test than those treated with ferrosilicon The titanium additions compared with the silicon additions had a marked effect in reducing the segregation of carbon at the top of the ingot This improvement was approximately proportional to the titanium additions but the effect falls off rapidly at the bottom ends of the A rails. Rail sections from the top of the ingots from titanium treated heats were more uniform in hardness than those from similar positions in silicon treated heats This effect had entirely disappeared at the bottom of the ingot. The results of tensile impact, and endurance tests did not show as much improvement from the titanium treatment as was expected from the decreased segregation

The Practice of Analyzing Metals by Means of X-rays is only in its infancy There is every reason to believe that soon great advances will be made in determining the crystallization and therefore the properties of metals Students of metallurgy are well aware that the properties of metals and other bodies depend on the nature of their crystallization The microscope has rendered valuable service largely because it enables the form and arrangement of the crystalline grains to be studied The X ray carries the same form of inquiry into a region 10,000 times more minute thereby furnishing new evidence as to crystalline structures so that it is now possible to see the atoms and the molecules, and the way they form crystals. Every crystal has its characteristic X ray spectrum and can be identified thereby even when the individual crystals are beyond the resolving power of the microscope and the substance is in danger of being called amorphous If a specimen contains a mixture of crystalline substances, the spectrum shows the combined effect of all the substances, and provided each individual spectrum is

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known, the specimen can be analysed —*Iron Trade*, 73 26, ½ p

Effect of Cold Work on Stainless Steel.—Most metals when distorted by cold work have a greater tendency to corrode than they have in the normal condition Stainless steel is no exception to this and when severely distorted it rusts comparatively readily for example a coil of severely cold drawn wire will rust into a solid mass if left exposed to the atmosphere for a few months The comparative resistance of the distorted and undistorted material can be shown, for example by placing half of a broken tensile test piece of hardened and tempered stainless steel (which had been polished all over before breaking) in a solution of sodium chloride, corrosion will commence at the distorted end As to whether corrosion will take place or not under stated conditions after a small amount of distortion depends on the composition of the steel and can only be settled by actual experiment, but the lessened resistance is always produced, just as it is by tempering a hardened sample It is for this reason that a polished surface on stainless steel is more resistant than a roughly machined surface the effect is due, however, not to the presence of polish on the former but to the absence of the distorted skin which is produced by the rough machining —*Practical Eng*, *Note*

The Calorizing Process consists in placing the material such as tubes in a rotary retort and heating in a reducing atmosphere of high temperature, the retort being filled with a mixture containing finely divided aluminum The treatment infuses aluminum into the exposed portion of the metal to form a homogeneous aluminum alloy This process is applied to materials already made It is not a cast alloy but a surface treatment by which aluminum is actually driven into the metal (not merely deposited) and forms a new surface of aluminum alloy The process is applied to steel or semi steel products such as pipe, tubing, bars or other sections, thin sheets or small pieces Calorizing renders material so processed resistant to heat, abrasion and certain corrosion particularly air water electrolytic alkaline and certain acid and other chemical actions The structural strength of the material is maintained and the coating is an integral part of the metal protected The electrolytic theory of corrosion explains the protective action of the aluminum coating of calorizing material Examination of a sample of corroded modern steel will disclose deep pits or spots where the metal has been eaten through by rust. Analyses show that steel products of today due to rapid production methods contain impurities that localize and hasten corrosion by electrolysis It is the familiar action of rusting in spots that is proving so troublesome in the application of modern iron and steel today Aluminum is electro positive to iron and because of the results secured by the process of impregnating aluminum into every void in the surface of the steel and alloying with the steel itself densifying the surface and building it up to protect the base metal, corrosion of the base metal is definitely retarded by calorizing —*Chem and Metall Eng*, 29 27, 2 pp

Titanium in Cast Iron.—The effect of titanium on the formation of graphite is somewhat like that of silicon but more intense This is true to such an extent that, independent of the content of silicon the upper limiting percentage of graphite formation is exceeded when the titanium total reaches 0 1 per cent. Until the maximum amount of titanium has been reached the graphite favoring influence of the titanium is greater than all other influences on mechanical properties. These properties are very greatly improved with increased content of titanium, but the percentage of graphite stays about the same Increasing the titanium content renders cast iron less soluble in acids.—*Stahl und Eisen*, 43 49, 4 pp. ill

A Study of Tarnishing carried out for the British Non Ferrous Metals Research Association has brought out for the first time the marked difference in the mechanism of corrosion with different metals This discovery promises to prove of the greatest importance both from a practical point of view and as leading to a further elucidation of the whole question of corrosion Three different types of tarnishing have been distinguished In the first type, represented by copper the tarnish film actually protects the metal from further attack, the progress of tarnishing becoming slower and slower as exposure proceeds. This is accounted for by

the supposed continuous layer which the tarnish film forms, and the consequent difficulty the corroding constituents of the air find in reaching the underlying metal. In a second type the tarnish film is neutral and the attack proceeds steadily, for instance zinc in a dry atmosphere; in this case it is probable that the film is pervious to the air. Finally, the corrosion, while starting off fairly slowly, may become accelerated and this forms the third type, exemplified by iron; it is suggested that here the corrosion product—rust—assists in the attack. Some metals, such as zinc, brass, etc., may follow more than one type of progress according to the atmospheric conditions or even to the thickness of the tarnish film. For instance, with brass the attack first proceeds uniformly but later the film exhibits a protective influence and the attack slows off.—*Metal Ind*, 24 1, 2 pp

Mining

The Consumer's Power to Make or Break the Coal Market is made evident by an analysis of the relations between consumer's stocks and price, and it is found that this relation is almost mathematical. A reserve below 30,000 000 tons indicates a seller's market, 20 000 000 tons indicates a panicky market, and above 40 000 000 tons indicates a buyer's market in which salesmen again take the road and solicit business on the consumer's terms. On last September 1st, commercial consumers and retail coal dealers had on hand an estimated total of 56 000 000 tons of soft coal, which is equivalent to five weeks' output at the present rate of production. To equalize the seasonal demand for coal and relieve the winter burden of railway traffic would require the storage during the summer of only 20 000 000 tons more than is already stored. American consumers can manage to find storage for this additional 20 000 000 tons. It could be put away without involving the construction of new yards, simply by utilizing more effectively the existing storage facilities or by expanding the crude arrangement of the ordinary small plant.—*Coal Age*, 21 25, 3 pp, ill

Chilian Nitrate Reserves are adequate for several generations according to a writer in *Engineering and Mining Journal Press* (117 2), who abstracts a long report on the subject which was submitted to Congress. It is stated that while it is very difficult to arrive at a full and accurate estimate of the amount of nitrate left for future use, the evidence that the reserves are adequate to the world's needs for many years is overwhelming. Mining is exhausting the beds, but improved technology is rendering lower grade material available. It seems fairly certain that long before the natural nitrate has been used up satisfactory substitutes will be available in adequate quantity. Roughly the output doubles every decade.

Mine Samples and Delivered Samples *of coal are not the same thing according to Technical Paper 344 of the Bureau of Mines.* Analyses of mine samples of coal are plentiful, but available analyses of delivered coal are relatively few. Mine samples are collected according to a standard method. The sampler cuts a channel 2 by 6 inches or 3 by 4 inches from roof to floor in the face of the seam and excludes from the sample any partings more than three-eighths of an inch thick and any lenses or concretions of "sulfur," or other impurities, more than two inches in maximum diameter and one half of an inch thick. Analyses of mine samples form a permanent or scientific record of the coal bed at the point sampled. In the purchase of coal, mine samples may serve as a sufficient guide to the experienced purchaser who has knowledge of the impurities in the seam and the degree to which these are eliminated in mining and preparing the coal. To the average purchaser, unacquainted with these details, however, dependence on mine samples may be misleading. The quality of coal indicated by the face samples can rarely if ever be attained in the delivered coal. Certain impurities that are eliminated from the formally prepared mine sample may not be eliminated by the miner interested in getting out a large tonnage. Some of the roof and floor may also be included if these are soft or flaky. Some mine analyses, particularly those taken from geological reports, may be either from outcrop coal or small workings not beyond the influence of weathering. When coal prices are high and competition is lessened it is easy for the miner and the management to lower the standards of preparation of the coal, and a return to rigid standards is always difficult.

The Service of the Chemist

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Retardation of Spoiling of Butter.—A new method of butter manufacture is now being tried out in Holland and is meeting with considerable success The main feature in this new process is that it delays the deterioration and the spoiling of butter The new process consists in conducting the churning operation in an atmosphere of carbon dioxide The air is sucked out of the churn and is replaced by carbon dioxide, which fills the pores of the butter and keeps out the oxygen as long as the butter is not vigorously agitated after exposure to the air The natural process of deterioration is accelerated by the oxygen and any temperature above the point where the butter fats would congeal and close up the minute spaces where the oxygen could penetrate and produce reactions The consumption of carbon dioxide in the new method of manufacture is said to be approximately one kilogram for every thousand kilograms of butter and its cost together with that of the process is considered negligible in view of the advantages gained —*Jour Ind Eng Chem*

Cashew Nut Oil—A series of experiments have been carried out recently with cashew nut oil in view of a suggestion that this oil could be used in pharmaceutical preparations in the same manner as almond oil The results of these experiments are published in the journal *Malaya Agricultural Journal* The experiments showed that the kernels of the cashew nut were rich in oil containing between 40 and 45 per cent In extracting the oil from the kernel it was found that due to the nature of the kernel it was necessary to exert a high pressure in order to get out of it the maximum yield of oil The decortication of the nuts is a difficult problem in view of the leathery nature of the shell and the presence of a vesicant liquid The cake which remains after the expression of the oil is rich in albuminoids In a sample obtained from the small laboratory hand press it amounts to 23 4 per cent of albuminoids corresponding to 33 4 per cent on the dry oil free residue

Changes in Powdered Rosin—Some of the so called constants of powdered rosin undergo pronounced changes within a short period of time even when the rosin is stored in partially filled corked bottles While the rate of change diminishes greatly after the first week it continues at a significant rate for at least three weeks At the end of six weeks the following changes took place The acid number had decreased 5 3 to 9 3 points the iodine number 47 3 to 52 2 points the saponification number had increased 5 1 to 8 0 points and the melting point 8 9 to 11 3 degrees —*Jour Ind Eng Chem June 1923*

Sirup From Sweet Potatoes.—A method for the commercial manufacture of sweet potato sirup based on laboratory and plant experimental work has been developed by the Bureau of Chemistry From the standpoint of quality this sirup has possibilities for use as a table sirup for cooking purposes and in the manufacture of colored and short grain candies For baking purposes it might find a use in dark products such as ginger snaps. It also has properties which make it suitable for use in blending with other sirup to prevent crystallization The commercial possibilities of sweet potato sirup are limited by the high cost of manufacture under the present method For further details see United States Department of Agriculture, Bulletin No 1158, July 3, 1923

Solvents for Making Vanilla Bean Extract.—Because of the restrictions on the use of alcohol which have followed prohibition and the consequent substitution of other solvents for the extraction of flavors, some preliminary work has been done to determine whether or not these alcohol substitutes produce the same quantity and kind of extracts as those prepared with the aid of ethyl alcohol The investigation was limited to several varieties of vanilla bean and tonka bean and the solvents selected were isopropyl alcohol ether acetone and carbon tetrachloride to be compared with ethyl alcohol The results show that the alcoholic solvents are much superior from the standpoint of quantity of extraction, the carbon tetrachloride being the poorest in this respect. It is possible, however, that a preliminary extraction with ether or carbon tetrachloride followed by a weak alcoholic solution may be found to be practical For further details see *Journal of Industrial and Engineering Chemistry*, page 782, August, 1923

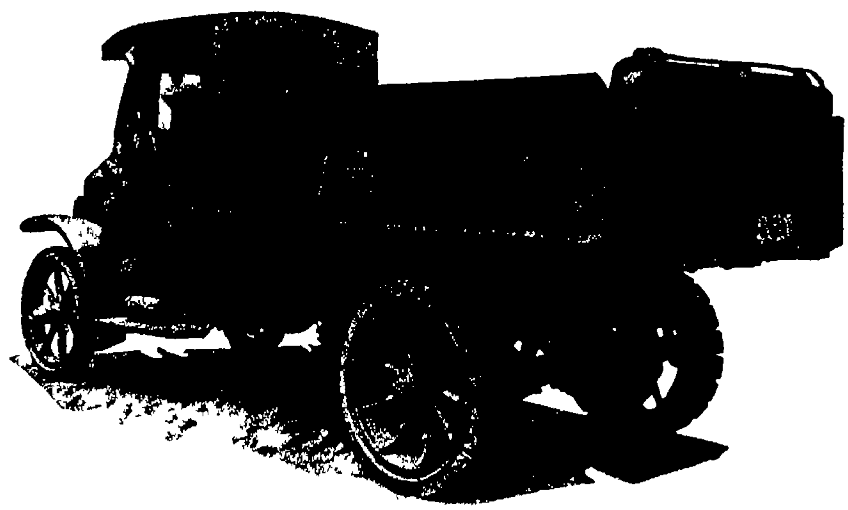
Making Flexible Artificial Leather.—The flexibility of artificial leather depends to a large extent on the character of the backing on which the coatings of nitrocellulose or aceto cellulose are built up For this purpose is now proposed a closely woven cotton fabric with considerable pile The fabric is dyed and passed through napping machines to give it a greater pile A series of coatings is then formed on this background from mixtures containing nitrocellulose and castor oil Then the material is embossed This product will resist the action of heat rain and snow and the wear from wind blown sand —*Export*

Pilchard Oil.—A description of the various properties and constants of pilchard oil is given in the *Journal of the Society of Chemical Industry* February 9, 1923, pages 47T to 48T The pilchard is a fish, a member of the herring family and the pilchard fishing industry is carried on almost entirely off the coast of Cornwall England The present method of obtaining the oil from the fish is somewhat crude, but the oil product is very clear and clean being free from nitrogenous and other rank impurities From one and one half to two gallons of oil are obtained from one hundred kilograms of pickled pilchards In 1921 there were produced 60,000 gallons of the oil which was utilized mainly for the manufacture of soft soap Inasmuch as the oil gums" readily when exposed to the air it is not suitable for lubricating purposes and for a similar reason it is unsuitable for use as a substitute for linseed oil in the manufacture of paints and varnishes The oil however yields a good soap which is quite transparent of pale amber color and equal in quality to the usual fish oil soaps

New Use for Dyes—In an interesting article in *Industrial and Engineering Chemistry* August 28 1923, P A Kober describes a reliable method for controlling temperatures in heating processes which consists in applying a liquid dye to the heated product the disappearance of or change in color indicating that the part to which the color has been applied has received a definite amount of heat. Many dyes break down readily on heating a large proportion of those found suitable belonging to the triphenylmethane series of dyestuffs Among possible applications the method may be used in controlling the annealing of glass or the baking of cements or other mixtures, and to indicate the overheating of parts of electrical apparatus and instruments. A further development consists in using two dyes to indicate when the heat applied has passed a maximum as well as a minimum temperature limit The following dyestuffs in certain proportions act as good double indicators Chemco Blue and Chemco Red C P 196 Malachite Green Malachite Green and Rubine Red Erythrosin and Neptune Blue

Use of Ozone in Ventilation.—In the past few years the question of utilizing ozone for purifying air in ventilation of buildings and also the air of refrigerating plants has been receiving much attention In the past the expense of production has been a great drawback to its extensive use The electrolytic method has been considered standard for several years Ozone being a rare gas with active oxidizing powers may be used for the purifying of air used in ventilating public buildings, for the removal of odors and for destroying bacteria. Its use has also been proposed for bleaching textiles and sterilizing them The United States Department of the Interior through the Bureau of Mines is cooperating with the Society of Heating and Ventilating Engineers in four different problems which are of considerable importance They are as follows Methods for the quantitative deter-

(*Continued on page 208*)



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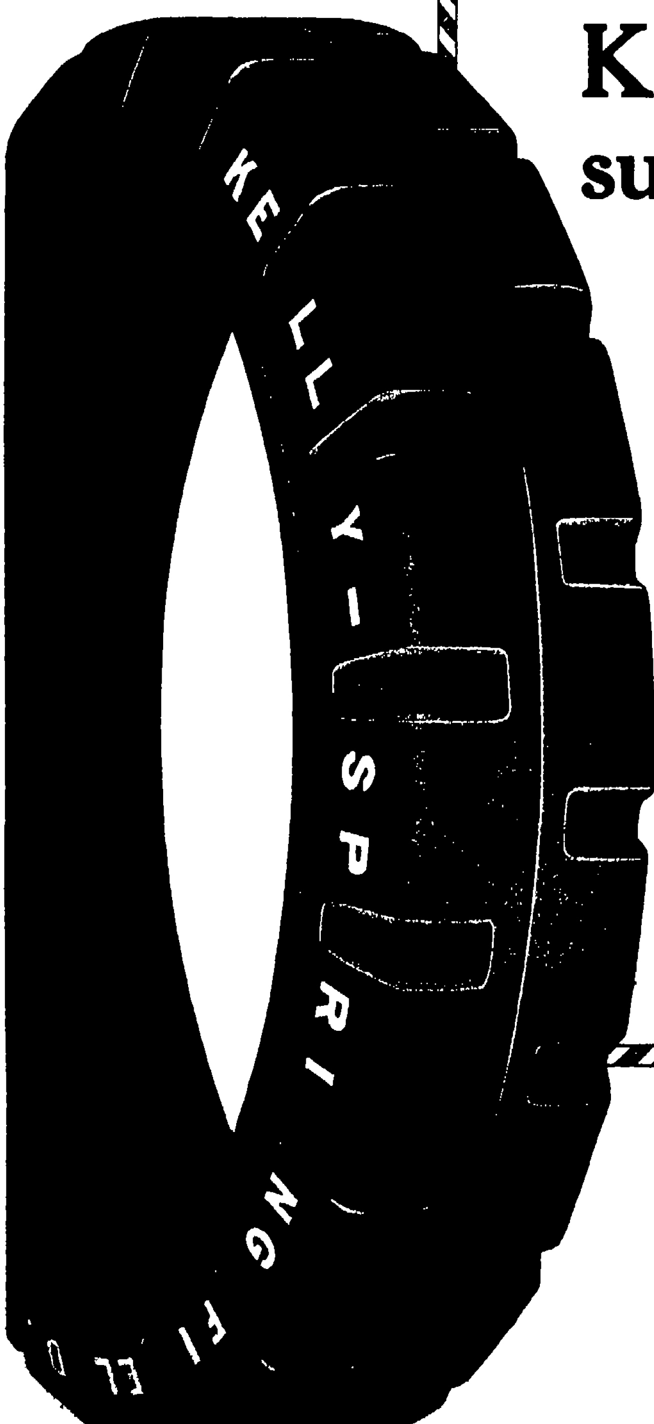

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Service of the Chemist

(Continued from page 200)

mination of ozone and oxides of nitrogen in ozonized air Amounts of concentration that will produce the desired results and the limiting amounts that are permissible to breathe without producing harmful effects Tests of ventilating systems in which ozonized air is used The use of ozone in connection with recirculation of air in buildings

Practical Use of a Rare Element.—For the first time in Great Britain an installation of neon lighting is now being applied outside the London Coliseum The apparatus is one of the most interesting evolved since the introduction of electric lighting Neon lighting is carried out by means of glass tubes from which the air has been exhausted and replaced by a small quantity of pure neon gas at a pressure very much below ordinary atmospheric pressure This neon gas is rendered incandescent by the passage of a high voltage alternating current passing between two metal electrodes fitted at the ends of the tube the color of the incandescent gas being a peculiarly rich form of flame color By means of a rotary converter the direct current supplied from the street mains is converted into alternating current that is required to operate the light.—*Chemical Age (London)*

Bean "Boards" Something New.—Bean boards is a new article which one of the mills in Dairen China recently started to manufacture It is used for feeding animals and is chiefly exported to America The boards are of rectangular shape measuring 28 by 12 inches, with a thickness of eight tenths of an inch By submitting them to higher pressure than is applied in the case of beancake they contain less moisture, rendering them less liable to become moldy in transit The venture is still in the experimental stage and its future is looked forward to with interest

No Saccharine for Belgium.—The importation manufacture transportation, holding and sale of saccharine and similar products, or the importation and manufacture of products containing these substances is prohibited in Belgium

Paper Coffins — Germans are being bothered even in death with financial problems At Zwickau a cardboard box serves to line a brick casket and in some other cities they use a coffin the bottom of which slides back after it has been lowered into the grave depositing the remains on the ground so that the coffin can be salvaged

Radium From Russia.—Soviet Russia is to mine radium ore and produce radium It will be kept at the Radium Institute of the Academy of Science which will maintain exact records of the production of radium and of supplies on hand without making requisition from the present holders

Destructive Action of London Fog.—The Houses of Parliament are in danger of losing much of their artistic beauty by the action of London fog which crumbles the stone, thus eliminating the finer details Frequently experts in examining inaccessible parts use powerful glasses and if the part looks suspicious a scaffolding is erected to enable a thorough examination

Labrador Gold.—The Geological Survey of Canada has issued a report which indicates considerable doubt as to whether placer gold is to be found in any considerable quantities in Labrador, which has been heralded as a new Klondike The chances for the occurrence of rich placer deposits seem very remote," and some of the advertisements relative to the reported goldfield seem improbable ' states the report. It is pointed out that Labrador was intensely glaciated and swept clean the ice sheet being unhampered in its movement seaward and that there is little likelihood of placers having since been formed in Labrador

Candy Does Not Supplant Alcohol.—The expected boom in the candy business by reason of the adoption of the prohibition amendment has failed to materialize according to the President of the National Confectionery Salesman's Association of America which had its annual convention recently at Atlantic City Apparently the only effect of prohibition on the candy trade was to bring into the business many inexperienced manufacturers who had anticipated an enormous increase in business. Strange to say approximately 60 per cent of the candy consumed in the United States is consumed by children in the form of "lollypops" or sticks.

Radio Notes

Re-Broadcasting American Programs in England has become a rather commonplace feat. Recently the programs of the Westinghouse station, KDKA, have been intercepted by English stations and re-broadcasted for English homes. The KDKA station has been transmitting on a 100-meter wave length for re-broadcasting purposes, and this wave has been picked up by the Manchester station of the Metropolitan Vickers Electrical Company and repeated on 385 meters.

A Mercury Variable Condenser.—There has appeared on the market a variable condenser which makes use of liquid mercury under pressure. The application of greater or less pressure causes the mercury to spread more or less over the mica dielectric and to produce greater or less capacity effect. The mercury is entirely enclosed, eliminating all possibility of dust and dirt and, therefore, leakage and noises. It is claimed that this new condenser will stand more than 5000 volts so that it can be used for low power transmission as well as for receiving. Because of the simple construction the price is quite moderate.

Radio and the Farmer.—A special survey of about 1200 farmers just completed by the U. S. Department of Agriculture has disclosed the importance of radio in the production and marketing of agricultural products. More than 50 per cent of the 1200 farmers reported that they owned tube sets employing three or more tubes. A large number have home made sets ranging from the simple crystal to the tube set. More than 75 different makes of sets were found among the manufactured sets purchased, although the bulk of the sets were confined to about 15 of the leading makes that are more or less widely advertised in radio and general magazines. The average cost of the manufactured sets was $172. Comparatively few of the owners of home made sets operate crystal receivers the survey revealed. The average cost of the crystal sets was $11. The average cost of the home made tube sets was $83.

Is the Regenerative Set on the Wane? —That is a question which is being asked and asked often these days. With the recent progress in radio engineering it is fair to state that the regenerative circuit no longer occupies the important position which it did a year ago. Better circuits have been developed which make for sharper tuning, less distortion and positively no re-radiation. However, the regenerative circuit has done more to bring about radio broadcasting than any other factor. It was available at a time when there was nothing else that could even be compared with it in point of efficiency. It permitted the construction of simple sets which would bring in radio phone signals from stations many hundred miles away. It made for loud signals, whereas heretofore, single tubes produced barely audible signals. Nevertheless, and despite the many ingenious tuners which have been devised of late to give new life to the regenerative receiver, the fact remains that regenerative circuits are being superseded by radio frequency, neutrodyne, superdyne, radiodyne, super heterodyne, and other circuits.

The Sealed Radio Sets of Australia.—A novel method has been adopted by the Australian Commonwealth radio authorities for protecting broadcasting stations. The regulations recently promulgated require that every prospective purchaser of a receiving set must present to the radio goods dealer a certificate of license showing that he has subscribed to the service of the station operating on the wave length to which the instrument being purchased is adjusted. If a radio enthusiast desires to listen in on additional programs he can have his receiving set so adjusted, but only on the production of certificates showing that he has made separate subscriptions to each. At a recent conference of Federal authorities, manufacturers, broadcasting companies, and dealers, the adoption of a uniform device for sealing receiving sets was decided upon. While the sealed-set regulations may be defeated by certain owners of receiving sets, the Government has authority to make surprise inspections of every set to see that the seals have not been tampered with. It is understood that the sealing device, which is added locally, will in no way interfere with the sale of American radio sets in Australia.

The Wave Trap is becoming more and more of a necessity in connection with sets which do not tune sharply and in localities where there are two or more transmitters at work on almost the same wave lengths.

Fortunately, the wave trap is a simple contraption and may be readily made or purchased complete at a low cost. The simplest kind of wave trap consists of a shellacked tube three inches in diameter, on which are wound ten turns of No 18 double cotton covered wire to serve as the antenna circuit. Around this winding is placed a layer of insulation, say oiled muslin, and a winding of 35 turns of No. 26 double-cotton covered wire. This second winding is connected to the terminals of a 43 plate or .001 mfd variable condenser. The first winding is connected to the antenna and ground, just the same as the receiving set. In fact, it is shunted across the terminals of the receiving set. Such a wave trap serves to "trap" undesired signals, which are tuned in for the closed oscillating circuit consisting of the second winding and variable condenser there to lose themselves, so to speak, and not get into the receiver which is tuned for another wave length.

The Superdyne Receiver now steps up to the forepart of the radio stage and basks in the limelight. Like most of the recent advances in broadcast receivers, the principal feature of the superdyne is its special radio frequency amplifying circuit. Both the input and output circuits of the first tube are carefully tuned to the incoming wave, which is an arrangement that is bound to give remarkable results. The possibility of oscillations has been eliminated by the ingenious device of a reversed tickler coil. The tickler gives the tube negative regeneration which discourages its tendency to oscillate instead of aiding it, as the usual tickler does. In tuning in on a station both the grid circuit and the plate circuit are tuned by variable condensers. If the set clicks and breaks into oscillation, it can be immediately stopped by a turn of the tickler or stabilizer dial. It may be necessary to turn the stabilizer at right angles to the grid circuit coil in order to pick up a station. As soon as the set starts to oscillate it should be tuned down immediately. Then, after both grid and plate circuits are tuned to resonance with the incoming signal the coupling between the stabilizer and the grid coil can be reduced until the volume of signal is as great as desired or until the set is just below the point of breaking into oscillation. Complicated as all this may sound the set can be operated with but little practice. It will not only tune sharply, but it will bring in distant stations with ample volume.

The Loud-Speaker Horn.—The popular conception of the function of a horn on either a loud-speaker or a phonograph is erroneous. We hear that a horn "resonates" or it "concentrates the sound" or it "amplifies" and many other explanations all of which are vague and most of them incorrect. It is true that a horn resonates at certain frequencies, and for that reason increases the amount of radiation at those frequencies. Any form of resonance, however is undesirable because it is impossible to increase the amount of radiated energy uniformly at all frequencies within a wide range by this method. If a horn is not to distort, its walls should be non vibrating and its air column resonances, within the range of frequencies used, should be slight. If we think of the term "amplification" as meaning the increasing of any form of response by supplying energy from another source, we see at once that a horn can not amplify because it can not supply energy, we learn from C R Hanna of the Westinghouse Research Laboratory. It should be evident, therefore that a horn merely loads the diaphragm in such a way as to cause more sound energy to be radiated into the surrounding space from the diaphragm. The term 'radiator" more accurately describes the action of a horn. A good horn, therefore, is one which causes the diaphragm to radiate almost uniformly at all frequencies within the desired limits. This condition is more easily attained in a phonograph than in a loud-speaker. In the phonograph the diaphragm is forced to follow the vibrations of the record except for the slight spring of the needle, while in the loud-speaker the diaphragm is not impelled to follow the variations of current in the windings because there is no rigid connection between the two. In the phonograph it is necessary only that the horn shall radiate uniformly at different frequencies for a given root mean square velocity of the diaphragm. In the loud-speaker the horn must fulfill this condition, and also help to cause the diaphragm to vibrate at a nearly uniform velocity when the same current at different frequencies is passed through the windings.

Electrical Notes

Geometry and the Photometer.—An icosahedron surface has been successfully used by the Westinghouse Lamp Co for the measurement of the very largest street lighting luminaires Such a solid having twenty faces each an equilateral triangle is more adapted to manufacturing than a sphere and occupies less vertical distance, without sacrificing any accuracy within the limits of commercial testing

Cement for Porcelain and Glass Insulators is now available It is sold as a dry powder with the necessary quantity of liquid hardener for mixing It is furnished in bulk quantities or in small lots, according to requirements This cement is said to be a porcelain putty that sets and hardens at normal temperatures No heat is used For cementing patching and repairing insulators of any size or type the new cement forms a homogeneous mass with the material of which the insulator is made In a few days it becomes as hard as flint so the manufacturer claims It is easily and quickly prepared After being mixed to the proper consistency it remains soft and pliable for several hours It requires no reinforcing and no heat to develop the full strength of the insulator

The 110,000 Volt 4427 Foot Span over Carquinez Straits, on San Francisco Bay is one of the interesting feats of high power transmission in this country The first crossing of the Carquinez Straits by a high tension transmission line was one of the stepping stones in the progress of the electrical industry The pioneers built well and the march of events with its demands for greater and greater blocks of power found the crossing structure adequate for the new requirements Constructed in 1901 for one 60 000 volt circuit with a spare cable, two additional cables were added in 1914 making two 60 000 volt circuits In 1922 coincident with the replacement of 60 000 volt pole lines by a 110 000 volt tower line the crossing was modified to allow 110 000 volts on the two circuits thus again practically doubling the transmission capacity

The Underground Duct System of wiring is becoming increasingly popular in commercial buildings For years architects and engineers have been confronted with the problem of installing sufficiently flexible systems of floor distribution for light power and signal circuits to care for future requirements Of late the problem has been aggravated by the tendency toward open offices, with the consequent uncertainty of desk locations and by the need in industrial plants of changing motor locations or feeder circuits because of changes in production processes According to *Electrical World* the new system of wiring consists of a grid loop or any other preferred arrangement of half round fiber ducts connected at intersections by junction boxes which are merely laid in position (not actually attached to the components of the system) and the whole incorporated in the floor fill so that outlets can be placed at the beginning or after the floors are completed Either single duct or double duct can be installed depending on whether the electric power and signal circuits are grouped in the same duct or separated Access to the duct is obtained through inserts or outlet fittings placed at the start or after the floor is finished

Electricity Roasts Beef for 5000 People—A new and unusual application of electric heating was made recently when electrically barbecued beef was served to five thousand people at the annual round up and celebration at Ephrata Washington We learn from *Electrical World* that four steers weighing about two thousand pounds each were dressed and prepared for the barbecue and roasted in a large electrically heated pit built especially for the occasion The improvised oven was 32 feet long, 4 feet wide and 6 feet deep Twelve heating elements each of 3 kilowatt capacity and consisting of about 150 feet of No 14 iron wire were placed one foot above the bottom of the pit. Sheet iron heat deflectors were placed one foot above the heating elements, and a foot and a half above the deflectors were placed iron bars to hold the beef Thermostatic control was provided to maintain an even heat in the pit The meat was first roasted at a temperature of 550 degrees for two hours. The heat was then reduced to 350 degrees and maintained at this point for four hours For the next six hours the temperature ranged from 250 degrees to 300 degrees. At midnight the meat had been roasting for twelve hours and the temperature was then reduced to 200 degrees and held there for twelve hours until the time of the barbecue

A Wild Night on the "Shenandoah"

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pulled forward the vertical rudder post a heavy member measuring ten inches by ten inches, so that the top of this post is now about twelve inches from the vertical It is needless to say that the covering fabric was in large part torn away from the wrecked frame and it will be understood that the steering of the ship, complicated as it was by the gaping hole in the bow became a very difficult matter

To any one unfamiliar with the problem of airships and their structure it would seem that the remedy for these troubles would be the simple one of strengthening the bow and stern construction but to do this means to add additional weight to the ship and reduce the useful lift to that extent But the useful lift, that is to say the difference between the dead weight of the ship and the lifting power of the gas is the capital with which the airship designer has to work, and every reduction in the lift means a corresponding reduction in engine power and speed or in the amount of fuel that can be carried and, therefore in the radius of action of the ship It is this demand for light weight with its consequent frailty of structure which renders the designing of a dirigible such a ticklish job Both German and English designers have stated that the 'Shenandoah is probably the strongest airship that has as yet been built yet we see what happens to her in a winter's gale of a few hours duration

The escape from these conflicting conditions lies in the direction of greater size Speaking approximately the weight of an airship increases as the square of her dimensions, whereas the lifting capacity increases as the cube Hence it follows that an airship 1000 feet long can be built relatively of much greater strength and rigidity than one 650 feet long Because of the greater relative buoyancy at his disposal, the designer can design such parts as experience has shown to be vulnerable with a sufficient margin of strength to stand up to their work As a matter of fact, the ships which are to be built with the assistance of the British Government for the service between Great Britain India and Australia and those which will be built by the American Company which has bought up the German patent rights will be of such dimensions as to make even the Shenandoah modest by comparison

Our Abrams Investigation—VI

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usable plane

Dr Abrams knew nothing or next to nothing regarding electricity even though he made use of electrical apparatus in his work Of course he would tell you that he was applying electronic energy to his diagnostic and treatment technique but even then he was on dangerous ground No less an authority than Professor Millikan probably America's greatest physicist in the field of the electron investigated the Abrams apparatus and stated that it did not rest on any sort of scientific foundation whatsoever Professor Millikan holds that the E R A claims are the height of absurdity If it is true that the electrons inside of atoms give off under suitable stimulation frequencies of definite period which are properly called electronic frequencies then these frequencies are billions of times higher than any which the E R A are using in their treatment, so that the use of the word 'electronic' in connection with the Abrams method is misleading and unscientific If there is anything in the E R A technique it is certainly not electronic, electrical or magnetic

Not only did Abrams know little or nothing about physics in the face of this he insisted on tying up physics with his theories at every possible turn when there was no possible tie up His writings may have been convincing to some medical men interested primarily in the medical aspects of the case but to the orderly and trained scientific mind, they were nothing short of bewildering His book "New Concepts in Diagnosis and Treatment" was typical of his weird and rambling writings of late In that work he failed to set forth his discoveries or describe his apparatus so that one could build the instruments and repeat his experiments. Early in our investigation we obtained a copy of this work, and try as we would to understand its seemingly significant contents, we had to give it up as impossible It proved to be an incoherent hodge podge. One might rise to say that perhaps our

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Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

New Telescope for Russia.—German papers report the delivery by an English concern of a huge telescope ordered by the Russian Government for the Nikolai Observatory on the Black Sea

Study Climatology and the Weather at Home.—Clark University now offers a course in home study of "Climatology and the Climates of the World" as a companion to that on "The Passing Weather"

"Why the Weather?"—This is the name of a service furnished newspapers by a syndicate supplying scientific news to newspapers Nearly everyone is interested in the weather and the newspapers can give up a certain amount of space to this subject with advantage to the public.

The Nightingale's Song in England.—A party of 60 recently stayed up all night in the Surrey woods to hear nightingales sing and they were well rewarded for their sacrifice of sleep and comfort Nineteen songsters were distinguished The spot selected was an old quarry

Meteorological Degrees.—This year two degrees were given in Meteorology by George Washington University The only other degrees of Doctor of Philosophy for Meteorology were given by Johns Hopkins University in 1899 Harvard in 1914 and 1917 and at Wisconsin in 1918.

Longer Sheep's Wool—Dr Serge Voronoff has announced a new discovery which may prove of great value to wool growers. He states that the transplanting of glands from one sheep to another will cause the wool to grow 10 inches longer than normal on the animal with the extra glands

Foreign Fauna Study—A traveling scholarship for the study of the fauna of foreign countries was announced by the Smithsonian Institution, which will devote the interest from a bequest of $50 000 to the project The fund was given to the institution by the late Mrs Virginia Purdy Bacon of New York Those awarded the scholarship which will rotate every two years will receive about $2 500 a year

Presence of Mind—A burglar in Wales, in a place which we cannot pronounce was undone by finger prints secured under peculiar circumstances. A maid servant was awakened in true movie style by the burglar's flashlight. She said she felt faint and asked for a glass of water which he gave her and finding no valuables took his departure He was traced by the finger prints on the glass and proved to be a pitman and an old offender

The Hippopotamus and the Tennis Ball—"Zeekoe" in life was a $5,000 hippopotamus in the Cincinnati Zoo Some ill balanced or thoughtless person threw a tennis ball into the cage and hippopotamus like Zeekoe' swallowed it The tennis ball was found wedged in the huge beast's stomach, where, unable to pass further through the narrow opening, it formed an obstruction which resulted in the animal's death after four days of suffering "Zeekoe" got by after swallowing a lady's mesh bag, but the tennis ball was too much

Burroughs' Memorial.—Henry Ford has given John Burroughs' place in the town of Esopus, N Y, to the John Burroughs Memorial Association In his will Mr Burroughs left 'Slabsides" and the house at Roxbury, known as 'Woodchuck Lodge," to Dr Clara Barrus and gave her exclusive control of both places as long as she should live. The Memorial Association which had intended to acquire both properties, was unable to raise the required money, but Mr Ford came to the rescue by obtaining the interest of Dr Barrus in "Slabsides," which he has turned over to the association

Fails to Find Insulin.—Experiments conducted by the Fisheries Bureau in an effort to extract insulin, used in treating diabetes, from the alimentary canals of sharks were said by bureau officials to have been "not very successful." Working with the Public Health Service the bureau obtained about 16 pounds of pancreas tissues from various species of sharks but a laboratory test failed to develop any insulin The present source of supply is the pancreas of cattle The failure of the experiment, however may have resulted from the length of time which elapsed after the sharks were killed and before the laboratory tests were possible

Professor Pickering Resigns.—Prof William Henry Pickering is to resign in September 1924, and will become Assistant Professor Emeritus. He was born in Boston in 1858 and graduated at the Massachusetts Institute of Technology in 1879 Professor Pickering is the discoverer of the ninth and tenth satellites of Saturn and has made many contributions to astronomical knowledge Professor Pickering in 1900 established the astronomical station for the Harvard Observatory in Mandeville, Jamaica, where he now lives. In 1891 he established the Arequipa, Peru, station of the Harvard Observatory and erected an observatory and telescope for Dr Lowell at Flagstaff, Ariz, in 1894

Elephants Increasing.—The elephant is a very useful animal both for draft purposes and for ivory A few years ago 70 000 were slaughtered annually for their tusks so that it seemed as though there was a good chance of the big animals becoming extinct. Wise laws however, have checked the destruction so that the number is increasing The war gave the elephants their chance and the British authorities in East Africa have also protected them South of Zambesi the elephant is virtually extinct and the Cape market for ivory has ceased to exist. At present Mozambique is the center of the ivory trade Oddly enough the Portuguese through whose hands it comes send nearly all the ivory across to Bombay, where it is sorted and cut and dispatched to the European markets. The world's supply of real elephant ivory is now about 250 tons a year

Tryparsamide for Sleeping Sickness.—Sleeping sickness of Africa is not the same as that known in this country It is caused usually by the bite of the tsetse fly, which spreads the trypanosomes, as the irritant germs that cause the disease are called The problem was to find some drug which would kill these trypanosomes in the blood in all parts of the body, and which would, at the same time, not harm the body, an exceedingly difficult and delicate matter Dr Walter Jacobs and Dr Michael Heidelberger of the Rockefeller Institute undertook this task. They took arsenic compounds and experimented with them, failing time and again to gain the desired effect, but noting the results carefully and altering the compound 63 times they finally succeeded That is why the drug tryparsamide, used with such success against the sleeping sickness and paresis, is known as A63, the sixty third arsenic compound The first experiments were conducted on animals, and when tryparsamide had proved its value, Dr Louise Pearce went to Africa and experimented with it on the natives.

Hawaii National Park.—The Department of the Interior has just issued for free distribution a 16-page illustrated booklet on Hawaii National Park which is described as a playground of easily accessible marvels available 365 days in the year The booklet describes the various park trips from the city of Honolulu The park is comprised of three separate areas, two of which are on the island of Hawaii, the third being on the island of Maui, this latter, the Haleakala section, contains the largest extinct volcano in the world within the crater of which it is said could be placed the city of Philadelphia The Kilauea section contains the famous "Lake of Everlasting Fire," which is so convenient of approach that automobiles are driven to the brink of the pit. The Mauna Loa section includes the huge crater of Mokuaweoweo at the summit of Mauna Loa, altitude 13,675 feet. The Mauna Loa trip is described as a three-day riding or hiking excursion from the Kilauea Volcano and it is said the lava formations provide a variation of interests that more than rewards one for the rather strenuous climb. Copies of the Hawaii Park booklet may be obtained by addressing the National Park Service of the Department of the Interior, Washington, D C.

Our Abrams Investigation—VI

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mentality was of insufficient capacity to grasp this great truth To which we reply with becoming modesty that we have mastered the Einstein theories the various works dealing with the intricacies of electronic structure of matter, and, what is especially pertinent, that our everyday work brings us in touch with all manner of new ideas which we must examine, understand appraise, and pass upon

It may not mean much to the average medical man that Dr Abrams, from our study of the man, knew virtually nothing about electricity We doubt if he could have hooked up a door bell and made it work He had no conception, apparently, of the need of a closed circuit. Look for instance, on page 272 of his work "New Concepts, etc, and you will see the wire carrying the "energy" running to one pole of a step up transformer—a one inch spark coil in this case He apparently did not know the difference between the primary and the secondary windings so in the text he simply states that it goes to "one binding post." The picture indicates that it goes to one pole of the primary A wire runs from one pole of the secondary to the ground, while another from the secondary goes to the human detector As he had no particular use for the other pole of the primary he left it vacant! Note on page 43 his difficulties in telling the N from the S pole of a magnet On page 143 he says 'the vibratory rate for tuberculosis is 15 ohms' Today it seems to be 42 ohms On page 187 we find this wonderful statement 'The voltage of the latter is usually very high and varies from 2 to 17 ohms Further on page 209, you will note this gem, 'An ordinary dry cell of 1½ volts and 12 amperes discharges from the negative pole an energy value of 70 ohms (with biodynamometer) This energy discharge occurs during the flow of the current irrespective of the distance of the poles on the body of the subject" On page 234 is another riddle The energy discharge from a giant magnet with a lifting power of approximately 100 pounds to the square inch has an energy discharge of only 32 ohms' (The English is Abrams as well as the physics)

What is it all about? This sort of thing may have impressed certain medical men to give up their orthodox and less spectacular methods in favor of E R A but to anyone with even an elementary knowledge of electricity and physics it simply does not make sense Was Dr Abrams totally ignorant of physics and electricity? Or did he intentionally write in this manner so as to surround his basic discoveries with impenetrable barriers of confusing and weird statements? Or again was he really sane when he wrote these things?

And then the nomenclature of the thing Dr Abrams was never at a loss for new names for the simplest kinds of things A resistance box became a 'reflexophone", a magnet became a depolarizer' a slide-wire rheostat with two electrodes became a biodynamometer electrodes became 'distal and proximal electrodes simple marks made by a tiny plumb bob moving over a smoked glass slide as the consequence of involuntary muscular action of the reagent's hand, became "gyrograms or 'pathograms a combination of spark coils tuning coils variable condenser electrodes and connecting wires became a sphygmobiometer and so on Little wonder that few of the E R A men remember the names given to these various instruments and to the various phases of E R A

Not alone in his writings but in his experiments there is the same sort of weird meaningless and even ridiculous atmosphere He was forever working on something new He went from one idea to another with little loss of precious time He would get together an assortment of radio instruments projection apparatus, frog legs measuring instruments and so on and announce to E R A circles that he was on the verge of measuring the disease energies and dispensing with the human reagent In recent months he had several young electrical men working on these ideas, some of whom soon left his employ after determining for themselves the small opportunities available for serious scientific development work We have been in touch with several of these men and have their stories He made full use of the supersensitive characteristics of radio oscillating circuits and loud-speakers, presenting the normal phenomena of these circuits, well known and understood by all

electrical engineers, as amazing new manifestations of the electronic forces

Dr Abrams may have been the greatest benefactor of mankind, as he has been represented by enthusiastic scribes and his ardent followers. He may have been that in thought and in spirit, but not by the usual signs Instead of presenting his discoveries to the world in the way of all the great medical pathfinders he preferred to keep them a dark secret. His apparatus has been kept sealed, so as not to disclose the working members, and has been leased to practitioners at rentals so high that they could ill afford to use the E R A method except for extravagant fees from their patients. The rebuttal to all this is that Dr Abrams desired to build up his technique in a lasting way, and to that end he insisted that a fair share of the vast sums of money received for electronic treatment should go towards the building of an electronic college and laboratory in San Francisco the foundation of which has already been laid Concerning the electronic college, more might be said at this time, but space forbids Suffice it to say that Dr Abrams did not follow the ethics of the medical profession in the matter of *giving* his great discovery to the world His estate is variously estimated to be between $2,000 000 and $5,000 000 No doubt, he was a true benefactor to many doctors who, before taking up E R A. technique were handling a rather mediocre practice, but who, later became quite well to-do in very short order This fact is by no means denied, if anything Abrams was quite proud of his helping hand to thousands of practitioners, raised from penury to affluence, as the saying goes

How did Abrams teach his method? So far as we have been able to learn little of tangible value was being taught the students in their short and expensive course and Abrams himself admitted that only half of them learned to make the diagnosis Many students have admitted that they had little chance to learn anything Abrams demonstrated his methods and made numerous diagnoses before his classes and it was for the individual students to grasp whatever they could Occasionally, they were asked to help in the procedure At the completion of the course the students would sign up for the Abrams apparatus and depart for home, there to work the thing out for themselves Some of them did make it work others did not. We know both kinds

Abrams was quite autocratic at all times He was the leader His word was final No one might question his method or his findings His students had to agree with all he said If he announced a reaction they had to experience it with him there could be no alternative It was decidedly Abrams' 'show from start to finish Many interesting things were done, to be sure but the students had no hand in the working conditions and there must have been little of evidential value in the demonstrations Yet—many of them were 'sold ' As many of them have expressed it 'There must be something in it, somewhere!"

If we may be pardoned for doing so we must record the violent temper of Dr Abrams He would *demonstrate his methods* just so long as conditions were of his own choosing However, as soon as someone endeavored to impose checks or some kind of control so that the findings would have evidential value Dr Abrams would express his violent disapproval and in many instances, he would leave the room in a towering rage We were informed of this state of *affairs*, not only through past instances but by persons quite close to Abrams Expressions of sympathy and serious apprehension were tendered to us, looking forward to the day, if it ever came, when we should meet Abrams face to face

When our investigation of the Electronic Reactions of Abrams was first announced we received a letter from Dr Abrams stating "I note that you contemplate investigating the ERA. I shall gladly place at the disposal of your investigators with that object in view, my personal services and all the resources of my laboratory in San Francisco"

It seemed as though our work would be materially simplified We also began to incline to the idea that Dr Abrams must have something basically true and provable and that he had been grossly misrepresented by previous investigators. Soon we began to suggest preliminary tests, which could be conducted by mail or express, we proposed sending out pure germ cultures, which were to be identified by his electronic diagnosis. This, we were informed, could not be done The test was not fair Then we proposed

sending blood specimens, prepared in whatever manner he might specify and with the cooperation of his duly appointed representative here in New York, so as to have the conditions fair and square. Dr Abrams again declined and wrote a long letter indicating in his customary involved and mysterious style why such a test could not be carried out. The main purport of his refusal was to the effect that since his 75 to 90 per cent accurate findings could not be compared with clinical findings the latter being so utterly wrong as to be of no value, how could we judge the results? We were in the midst of formulating still other test conditions such as submitting one set of blood specimens getting his readings, and then taking the same set, changing the identification numbers and re-submitting them for a check up on his own original findings when we learned of his unfortunate death However, from what we had experienced and what we have seen and heard in the past, we sincerely doubt that Dr Albert Abrams would ever have made a test for us

His last letter to us dated January 7th, dealt with several matters. It indicated a worried state of mind as the result of the Arkansas trial and the impending State action in Ohio It pleaded for time as regard tests, inasmuch as a committee was being organised by one of the electronic organisations for the purpose of cooperating with us and inasmuch as Dr Abrams would have to consult that committee It again brought up the report of our test with Dr X, as reported in our November issue, and deplored the effect of that report on E R. A activities. It again brought up the essential difference between E R A findings and clinical findings, and the impossibility of reconciling both these methods for passing on results Six days before his death Dr Abrams wrote

You must remember that I have tried to point out to you on numerous occasions, that a test of this method cannot be compared with clinical findings and a committee of men before they can appreciate a test, must qualify themselves as to the basic principles of my method so that they them selves can sit down and repeat that same test with similar findings' Apparently if we don t get these the test doesn t count' Apparently if we don t get them once, we may get them if we try again'

Five months of close observation of E R A diagnosticians at work and study of the entire technique lead us to believe that the matter is by no means a bare faced fraud Many of those engaged in the work—Dr Abrams for one—are apparently sincere They believe in the method When they get proper results they are elated when they get unsatisfactory or even ridiculous readings they are bewildered and search for some far fetched explanation of a pseudo-scientific nature

The whole thing bears striking resemblance to the subjective psychic phenomena Compare it with the Ouija which spells out messages through subconscious muscular action Compare it with automatic writing in which one s hand traces mysterious texts quite without one s volition and quite foreign to one's state of mind Compare it with the fact that three or four people can push a table all around a room without the slightest idea that they are pushing it at all The E R A technique is such as to leave the gravest ground for suspicion that it works—when it does work—in just this way

Its weak spot is not made clear in the literature of the system that is designed for public consumption The layman gets a picture of the Abrams practitioner applying the apparatus to the patient and reading off the results from a dial, a scale, or some other recording mechanism If it were so, of course subconscious manipulation by the doctor would play no part No matter what the state of our subconsciousness we cannot make the thermometer or the scales give us a false record

But the Abrams practitioner does not have an instrument that makes its own readings He has to set the indicator to a *given index*, then he goes through a procedure which in effect answers yes' or "no" to the implied question whether *that rate* is present. And the means of getting the answer is itself objectionable in that it consists merely in the doctor s getting a certain sensation It takes the form of a changed tone on tapping the reagent's abdomen, or a sense of greater or less roughness as the finger tips are passed over his skin, or the degree to which a glass, rubber or wooden rod sticks when thus passed

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Our Abrams Investigation—VI

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When the practitioner sets his rheostat switches for a given rate he knows precisely what he is trying for The very fact that he sets for one rather than another rate means that, consciously or subconsciously, he has guessed that the patient has or has not a certain ailment The very fact that he knows the patient's history from the statement accompanying the blood specimen, or that he has the patient there before him, makes it impossible for him to try one rate after another without the conscious or subconscious knowledge that the facts lean toward this finding and away from that one Finally under the Abrams doctrine pretty much everybody has syphilis and one or two other certain things How can he help getting the reactions when he knows that he "ought" to get them and failing when he knows that he "ought" to fail?

The collateral aspects of the matter support this viewpoint strongly The reactions are very uncertain sometimes positive, sometimes merely a matter of guessing one way or another The state of mind of the diagnostician has much to do with his findings Though it may have taken him six months to acquire the ability to "get" the reactions he may lose this ability, temporarily or permanently, over night—especially if he begins to doubt the technique A spectator with a skeptical turn of mind is apt to drive the reactions away especially if he voices his disbelief (the psychic member of the staff interrupts to remark "Where have I heard that before?") When the blood specimens or germ cultures are known to the diagnostician the reactions are positive clean-cut and readily elicited and he can get the same reaction out of the same specimen time after time With unknown specimens of either sort the reactions become weak and uncertain they cover a wide range quite after the shot gun findings of Dr X in our one formal test and a shuffling about of the specimens followed by their presentation in a new order finds the practitioner unable to duplicate the results of a moment ago

All this gives the strongest grounds for asserting that the whole thing is psychic—a trick of the subconscious mind puzzling to the layman but clear as crystal and familiar as daylight to the psychic investigator Persons close to Abrams have always contended that whatever else be said about the man he was sincere He believed in what he did When the reactions failed him he was always keenly disappointed and plainly bewildered And this happened with sufficient frequency so that he knew he could not submit the reactions to a scientific test And it is our present belief that he knew the psychic nature of the whole procedure knew that the diagnostician got out of the apparatus only what he put into it He knew, we believe, that he himself was the "electronic reactions" just as any other honest E R A practitioner is his own electronic reactions" This phase of the matter is now receiving our closest study and we shall probably have more to say on it in a later article

In his letter of January 7th Dr Abrams went on to ask that we publish the findings of the International Hahnemannian Association which sent two of their committee to San Francisco to stay with Dr Abrams for two months in order to master the technique and pass judgment on its value The report of the findings of that worthy body is an *interesting document* It describes the technique and its results It admits the existence of the so-called electronic reactions and their applicability to diagnostic work but with several reservations By no means does this report accept the Abrams method as a perfected product.

Now that request of Dr Abrams was fair enough When the report of the International Hahnemannian Association first came to our attention, we were deeply impressed That association is to be commended on the scientific and business like manner in which it has investigated the claims of Dr Abrams, and more particularly his method We immediately got in touch with the very men of the International Hahnemannian Association who had investigated E R A and made the report And since then, over a period of several months, we have been working with them in their experiments with the so-called electronic reactions At this state of the experimentation, it would be unwise for us to publish the original report, in that it is to be modified by subsequent reports of that association, and in that much remains to be done before a final opinion can be passed on this matter

It has been said of Dr Abrams that he could measure the span of life of any individual by means of the electronic emanations from a blood specimen He measured his own span of life and he is reported to have predicted his death during January of this year That may be true However, it seems strange that he should have closed his last letter to us by stating that he would probably not get to New York until some time in the Spring

Dr Abrams is no more His teachings are in the hands of some three thousand or more practitioners in this country alone Several experimenters are spending large sums of money and unlimited time endeavoring to discover the mysterious energy at the bottom of E R A technique With the interesting and baffling personality of Dr Abrams no longer available as the foundation for the entire E R A edifice, no longer available as a buffer against investigation the truth must soon be discovered since it is the technique itself which must now stand or fall

The Chemistry of Bread

THE Food Research Institute in its first publication just issued from its headquarters at Stanford University points out the wholesomeness of the stale loaf, shows *the waste produced by present bakery practices* and urges further investigation of the question as to why some bread keeps better than others

The assumption that staleness is caused by the loss of moisture from the loaf is not tenable, for the report points out that what probably occurs is that much of the moisture in the bread is held by the starch which has been gelatinized in the baking As the loaf comes out of the stove this starch jelly distributed through the bread contains all the moisture it can hold As the bread cools the starch gives up some of its moisture, and this moisture is absorbed by the other constituents of the loaf changing the crust from a brittle material that crunches between the teeth to a soft and pliable one while the gluten of the crumb is given a toughness and firmness which as fresh bread it did not have The bread becomes stale at low temperatures and this accounts for the fact that bread when stale, but not dry, can be freshened up by heating The process is reversed and the starch jelly reabsorbs the moisture from the other bread constituents.

"Thirty Years of Psychic Research"

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excellent translation by Fournier d'Albé gives assurance that here as with Mr de Brath's rendition of Richet's book, knowledge of the subject as well as of the language has had full play

The case of Eva C has been a much controverted, and a bitterly controverted, one The present book will not clear it up to the satisfaction of all because the Baron plainly does not entertain as seriously as the investigator ought, the hypothesis of fraud He even shows excessive naiveté in the presence of what can fairly be characterized as strong evidence of fraud Thus when one of Eva's 'materializations' carries on its face a page-heading from 'Le Miroir' the journal from which Eva is charged with having clipped pictures for use in this fashion the Baron records the fact with the very extraordinary remark that he has no explanation for it. Nevertheless, this is the first approach to a complete account of Eva's mediumship that has appeared and it is of great importance Every serious student of psychic matters ought to read it and form his own ideas of the evidence for materialization which we think, for the present at least, must rest largely upon Eva Even the general reader though he would probably tire if he attempted a close examination of every page will find it well worth while to make a first hand acquaintance with this interesting episode in psychic investigation Not the least important feature of the volume is that in this English edition, there is included the Baron's rejoinders to much of the newspaper criticism which flowed so freely upon publication of the first German edition It is only fair to say that much of this criticism displays the same haste and the same ill-consideration which it charges against the Baron Schrenck Notzing, by the way, like Richet, rejects the spirit hypothesis—though he does so rather more tentatively than Richet, and like Richet, he has no very well formulated alternative to offer in its stead We make this remark with no critical intent, it rather well represents our own present state of mind, too.

The Story of Steel—III

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their share in building up this wonderful system of Lake transportation. Their most notable work, outside of the provision of lighthouses and the dredging of harbors, has been done at and around the rapids of St. Mary's River, where they have dredged and blasted some 45 miles of canal, with a least width of 300 feet and a minimum depth at low stage of 21 feet. Other notable work has been the construction of a series of locks, two of which are the longest in existence. These include the Weitzel Lock—515 feet by 80 feet; the Poe Lock—800 feet by 100 feet; the third lock 1350 feet by 80 feet, and the fourth lock of the same dimensions. The various channels approaching the locks, through St Mary's River and elsewhere, are excellently lighted, and the captains of the ships, through long familiarity, navigate these channels, even in very foggy weather, with an accuracy and absence from grounding or collision that is positively uncanny.

We reached the easterly end of Lake Superior at night and in thick weather, and therefore anchored outside the canal. During the night the stream of traffic coming up behind us halted also, and when day broke and the fog lifted there were some eight or ten big freighters, fully loaded, bunched around us. We tied up alongside the pier awhile, until two big 12,000-ton ore boats which were in the lock had steamed out. We then entered, being followed by an other ship of our own size. Two other vessels occupied No 4 lock and as showing the immensity of this traffic, the writer noted from the pilot house that, including the ships in the locks, those waiting to enter at each end and those which had passed through and were starting to the eastward or westward, there was an aggregation of ships which the captain estimated to total over 150 000 tons in capacity.

We have said that navigation is totally different on the Great Lakes, and certainly the end of our journey bore out this statement for we proceeded, in spite of our length of over 600 feet, to steam up a narrow, winding creek averaging 250 feet in width and with turns of 90 degrees to our destination the Lorain Steel Works, where we were to discharge. A powerful tug at the bow, a series of alternate full ahead and full astern telegraphs to the engine room, combined with an amazing amount of churning up of soft mud landed us finally at the great ore docks of the company. Before we tied up alongside, the hatch covers had all been opened and four Hewlett unloaders moving into position on the concrete wharf, spaced themselves along our 400-foot length of cargo hold.

These unloaders are one of the most amazing mechanical contrivances of all the many amazing things connected with the United States steel industry. I was standing amid ships looking down into one of the holds when a voice from the air called out "Good morning did you have a fine passage?" and looking up I saw the huge grab bucket and the vertical bucket leg of an unloader descending to enter the hatch. The voice was from the operator of the grab who as will be seen from our illustration, has his cabin inside the "bucket leg" and a few feet above the bucket. As he passed me he pulled a lever and the two halves of the bucket swung apart until the opening was over twenty feet. Down sunk the great mass deep into the pile of ore below. Another lever was pulled and the jaws crunched together and the operation of a third lever caused the whole leg and bucket with its load of ten tons, to rise vertically into the air. Then the grasshopper like, double walking beam moved back until the bucket was within the pier line when it opened and let its contents fall into a hopper and thence into a lorry, which immediately was drawn inshore upon the framework of the unloader to discharge itself into ore cars on the tracks below. The walking beam section of the unloader then moved forward again until the bucket leg was over the hatch when it descended for another grab. I timed the operation and found that the cycle took just one minute.

This was a ten-ton unloader, but some of the later and larger machines are capable of picking up 17 tons at one grab, and with this in mind it can be understood how the records of unloading mentioned above in this article were achieved.

Thus, we have followed the ore from the time when it was dug out of the Hull Rust pit to the time when it was deposited in the stock pile alongside the blast furnaces, 800 miles distant. At the rate of 16 tons for each scoop it was torn loose from its age-long resting place in the ore body; and at 17 tons to the grab it was picked up and brought ashore at the end of its long journey by water.

More Steam-Engine Power Without Steam

(Continued from page 168)

one-half minutes for the new liquor to be heated up to a pressure of 20 pounds per square inch as read off the pressure gage. The engine was started running and the pressure then fell to about 18 pounds per square inch, but stayed there during the entire course of the experiment, going up slightly as load was put on the engine. The engine ran perfectly and even after 18 weights had been placed on the beam pan, it still continued running.

The conclusion must therefore be drawn that the new power medium will develop six times as much power as steam under constant conditions. It was interesting to note that the exhaust from this engine was direct to the air, and in the case of the new liquid it was almost in the form of a liquid while in the case of steam it was hot vapor. Furthermore the engine itself was perfectly cool when run with the new power medium but rather hot when run with steam.

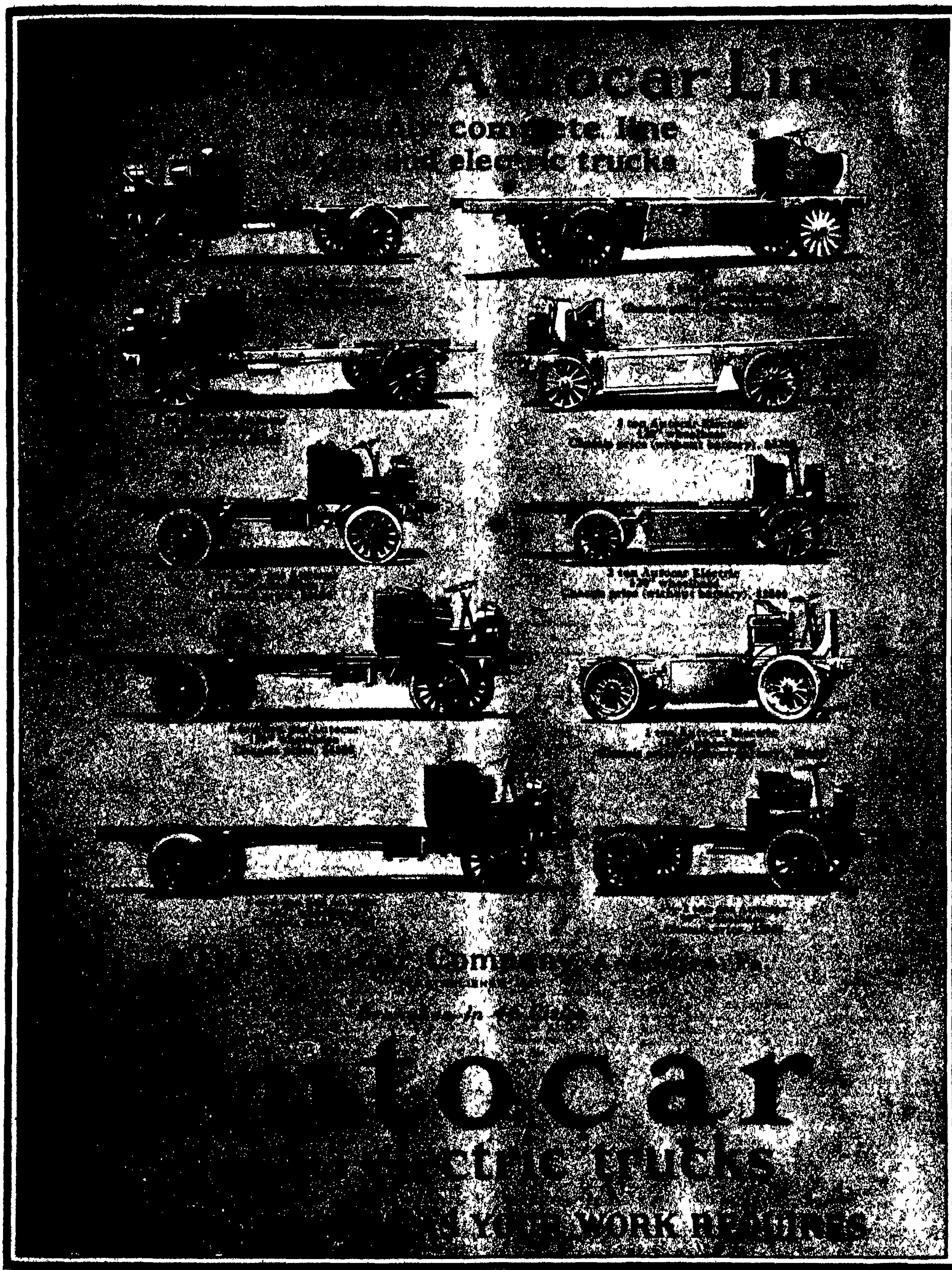
There have been quite a few uses suggested for the new power medium. In general it may be said that it will find a field in every phase of power generation. Thus it has been suggested that it can be used in central station plants for developing power, in city water and sewage pumping stations. It has an application to marine transportation. Railroad locomotives and cars can be run with it. It may be applied for generating power in mines, mills, factories, quarries, sawmills, cranes, etc. on the automobile, in airplanes and airships, where its non inflammability would be extremely advantageous, for driving ice machines—there are in fact innumerable possible applications.

In closing it may be said that this report was written as a corollary to an investigation made to determine if the claims of the inventor were really true. What has been seen convinces the writer that this new liquid will actually develop a vapor which will run a turbine or a reciprocating engine. Furthermore, it will do so in a closed system wherein the same liquid is used over and over again. As far as could be determined this repeated use of the same liquid does not result in its decomposition. Finally, it appears that more power is generated at less heat in comparison with steam.

Laying the Ghost of a War-Time Trouble

(Continued from page 180)

war debts of one sort or another of tens of billion dollars are trifling. It means that either we must grow more foodstuffs, and not only completely feed ourselves, but export replaceable foodstuffs to maintain our foreign trade balance, or that we will lose our prosperity and our standards which are the highest in the world will sink to the lower level of those of foreign countries. Uncle Sam's new lands of the West are gone our old lands are wearing out. The productivity of our American soils must be restored by every possible means. To restore these soils requires just three elements, no more phosphorus, nitrogen and potash. Of phosphorus, we have in the vast phosphate deposits of the West an inexhaustible supply, the greatest in the world. Of nitrogen, there is an inexhaustible supply in the air. It can be captured by such mechanical means as at the Muscle Shoals plant, and by nature working through the clovers, sowpeas and other leguminous plants which by strange bacteriological action condense thousands of tons of it annually—so that there is no shortage of these two elements. Potash is then the key. Our practical men of science believe that we have this key that it exists in the shape of millions of tons of soluble potash salt deposits in the Southwest. The interests of the people, whether the people realise it or not, demand early and reliable information as to the exact location, size and richness of these beds. If the question of the manufacture of nitrates at the Muscle Shoals or other plants is one for the politicians and the farmers of the country to get moderately stirred up over, the question of locating American potash salts deposits is one that is worthy of a revolutionary uprising. The drilling of wells using core drills which will show just what is being drilled through, and, when the beds of potash are struck, just how thick they are, is imperatively needed.



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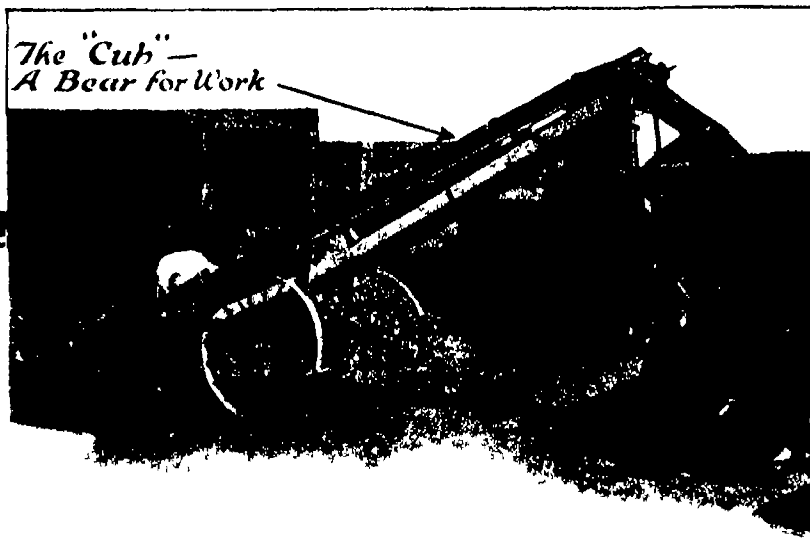

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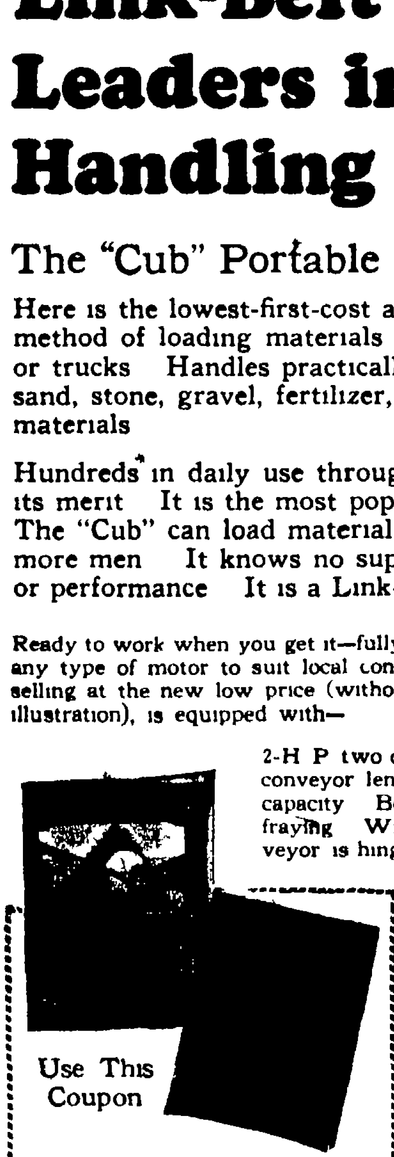

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With the Editors

WE DRAW particular attention to the story on pages 228 and 229 of this issue, describing the mechanical side of Morris Gest's brilliant production of "The Miracle" This is one of a series of spectacular engineering stories of the stage, previous numbers were the description of the Earl Carroll Theater, and the account of the production of "Johannes Kreisler Other stories of this character will appear from time to time, as the managers put out material worthy of such treatment Our procedure for these theatrical stories is to send the artist to the theater, and let him live there, on and off the stage, in and out of the audience during the performance and during the periods of preparation, until he is thoroughly familiar with the whole apparatus. Then he goes back to his studio and makes a working sketch for his big drawing This he puts before the stage manager and various other members of the theater staff, and before us, and after all possible corrections and suggested improvements have been made he goes ahead with his final drawing About this, with the artist's collaboration, we write the text and the captions, giving what amounts to a first hand account of this interesting field of engineering, so wholly neglected by many of our contemporaries.

OUR regular readers will recall a year or so ago, a series of three articles by Guy E Mitchell, of the United States Geological Survey, detailing the adventurous side of the work of the men who go out into the field with transit and note book and bring back the material for the wonderful topographic maps which are rapidly coming to cover the whole country Several months ago the daily press gave much space for a few days to the dangerous position, the possible loss and the ultimate safety of a party of Government surveyors who had undertaken to shoot and map the Grand Canyon of the Colorado From Mr Mitchell's fluent pen we now have an authoritative tale of just what happened to this party and why just what they were doing in the canyon just what their adventures were and how narrow was their escape from disaster

ANOTHER very interesting tale comes to us from well we don t just know whether it comes from the Arizona desert or from the mountains of the moon The point is to be found mainly in the celebrated "meteor crater" of Arizona a huge hole in the earth with a raised rim around it For some time controversy raged as to the method of formation of this crater Was it an extinct volcano of unprecedented size for terrestrial volcanoes or was it the result of a mighty blow dealt the earth by a huge meteoric wanderer? At an early stage of the argument the great similarity between Meteor Crater and the thousands of craters on the moon was noted, and orthodox science argued that since the moon craters were obviously volcanic, Meteor Crater was volcanic too The owner of the Arizona specimen now tells us that the shoe is on the other foot that he has proved his crater to be an impact crater, and that from this it follows that the astronomers must grant that all the little pot holes on the moon have been shot into our satellite by meteoric projectiles. He presents his interesting arguments, with a wealth of interesting pictures, in an early issue, and while they have not yet been accepted by orthodox science, there seems excellent reason to anticipate that they may be

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ELECTRICAL engineers are perpetually puzzling their heads over the necessity of carrying high tension currents through cables under circumstances where proper insulation is at once abnormally difficult and unusually essential Particularly when cables must go underground they must be placed together numerous cables in a single conduit and the insulation problem becomes the controlling aspect of the situation The most effective insulation that has been found for use in such places is of paper How the cables and insulation are made and how the paper is wound around the cables forms the subject of an interesting article which is scheduled for the May number

ONE of the numerous contributing editors listed on this page none is more active than Dr Luckiesh Dr Luckiesh and his laboratory have found out more things about light and lighting than an earlier generation would have supposed remained to be found Of utmost importance for instance is the investigation of the manner in which inadequate illumination not merely increases the difficulty of seeing and makes us work harder to see but actually makes us see more slowly so that, if our work involves the use of our eyes we get less done in a given time under poor conditions of illumination This is another of the features which we can promise for an early issue

WE CANT promise it more definitely than that because while the completed manuscript lies before us as we write we never know until the last gun fires what we shall have in the way of last minute stuff and what will as a result be forced to wait another month The Teapot Dome story in this issue is a case in point obviously it could not have been included in the original plans for the April number which are formulated around the first of February, obviously then something had to go out to let it in So when something that has been mentioned in this column does not appear promptly, don t get impatient over the delay we have the story, or we wouldn t mention it here

ACCORDING to present plans—which have at least two weeks to go astray in the next installment of the traffic series will be made in Connecticut to an even larger extent than the present one Commissioner Stoeckel and his staff have put a lot of gray matter into the consideration of how to prevent accidents and their first and foremost conclusion is that you can t prevent them unless you have a vast fund of information as to how and when and where and why, they occur A system has accordingly been installed in the Nutmeg State under which every accident gets reported in full to the commissioner's office and then gets put through a statistical mill of extraordinary efficiency calculated to bring out with the utmost clarity its relations with other accidents and with the matter of prevention As a result of the intelligent compilation and intelligent use of these statistics a large number of places through out the State at which accidents were formerly frequent have been identified and analyzed in search of their bad features This has led not merely to the reduction of accidents at these points but to recognition of the general features of lighting and road surface that promote accidents We shall exhibit the system under which all this has been done

EIGHTIETH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK APRIL 1924

U S Navy dirigible "Shenandoah" swinging at the tall and sturdily constructed mooring mast of a 450 foot supply ship

The Mooring Mast is the Thing

By J Bernard Walker

ONCE launched in the air the airship should stay there returning to its hangar only when major repairs or general overhauling and repainting are necessary The hangar should be regarded as having the same relation to the airship as the drydock has to the ship of the sea Foremost among the perils to which a seagoing ship is exposed is that very *terra firma* upon which she was built If her great fabric so much as touch the coast or the sea bottom it is liable to be badly broken or wrecked beyond repair When she enters port she makes fast to a mooring, where she may swing head to tide or wind or she is moved slowly and gently to her pier and protected from rude contact with its masonry by carefully disposed fenders

If mother earth is dangerous to the sea ship it is doubly so to the airship If contact with the unyielding ground is perilous to the frail shell of the ship it is immeasurably more perilous to the delicate shell of a dirigible as the loss of many of the early Zeppelins so clearly proved More than one of these was destroyed as it was entering its shed—a puff of wind serving to swing the hull against the doorway and break its back Others were lost when they came to earth during a trip *for repairs or replenishment of fuel*

These disasters and they were frequent proved that moorings were as necessary for the ship of the air as they were for the ship of the sea and that it was as foolish to ground an airship upon the land at the end of a voyage as it would be for a skipper to run his ship ashore every time he entered port

As long ago as 1910 the writer drew attention in the SCIENTIFIC AMERICAN to these self-evident facts and suggested that the only rational way to handle the airship, between cruises, was to moor it to a rigid and lofty mast The suggestion was first put into practice several years later by the Vickers Maxim firm, and its practicability was proved when airships in England remained moored in the open for several weeks on end and rode out gales in which the wind rose at times to 50 and even 60 miles an hour

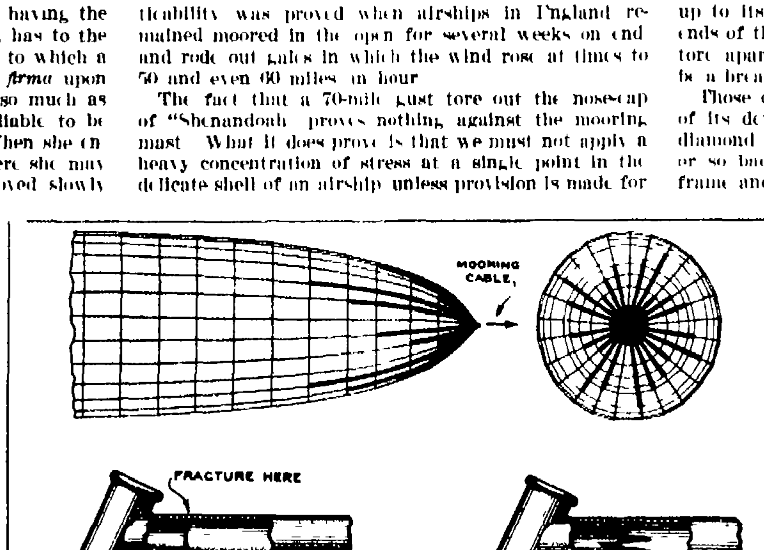
The fact that a 70-mile gust tore out the nose-cap of "Shenandoah" proves nothing against the mooring mast What it does prove is that we must not apply a heavy concentration of stress at a single point in the delicate shell of an airship unless provision is made for the immediate distribution of that stress throughout a large contiguous area of the hull It was in part the omission to do this that caused the failure The nose cap is a cone of metal plate which stood up to its work To this were riveted the converging ends of the relatively light longitudinal girders These tore apart just beyond the nose-cap If there was to be a break it was certain to come just where it did

Those of us who rode the bicycle in the early days of its development will remember how frequently the diamond frame failed by bending or fracture an inch or so back of the steering post Connection between frame and post was made by inserting a short stub-end of tubing in the frame and brazing the whole together The fracture always came at the point where the stub finished The *sudden* decrease in section was an invitation to fracture The end of the stub was tapered into four fingers of diminishing width There was no longer a sudden reduction in section the resistance to bending stress was distributed further along the tube and breakages ceased

Now like treatment would produce like results in this mooring problem Distribution of stress could be secured by leading light cables or wires of plough steel from the nose-cap along and within the longitudinal girders and attaching them to the girders at the successive circular frames Four cables should lead to the first ring four to the next and so on until the sixth ring was reached By spacing the points of attachment at 90 degrees around each ring the pull of the mooring cable would be distributed *evenly*, over the first 75 feet of the ship

To ensure immediate and equal transmission of stress the cables before insertion should be stretched to just beyond the elastic limit and given a permanent set Each should have a turnbuckle at its mid length and all of the cables or wires should be set up to the same tension

(Continued on page 281)



Lower drawing shows how breakage of bicycle frames was prevented by tapering off the section of the inner reenforcement The upper drawing shows same principle applied in distributing the pull of mooring cable by light cables or wires, attached at 24 points in the first 75 feet of the ship's hull

Flying Around the World

The Route Laid Down for the American Fliers Who Will Attempt Circumnavigation

By Lieut. Corley P McDarment

THE first canoe was undoubtedly tried out in a small pond before inter island trips were attempted, the first steamboat oozed up and down sheltered rivers a long time before an attempt was made to take it across the ocean And the airplane? It is a short time even in the modern world of speed since Dec 17, 1903 when the Wrights made a duration flight of 59 seconds a long distance flight of 852 feet broke an altitude record by ascending to a height of 20 feet, and sped over the ground at the rate of 10 miles an hour in their first airplane

The Douglass World Cruiser, with wheeled landing gear, at rest on the ground

Gradually and often tragically all of these records have been broken Faster and faster have airplanes speeded, more and more reliable have the motors become until now aviators firmly declare that a flight around the world is possible and to prove the matter the United States Army Air Service will start a fleet of four airplanes on a journey around the world April 1, 1924 This will not be the first attempt to encircle the globe by air The intrepid Major Blake of England started on such a journey in 1922 and traveled the route from London to Calcutta where illness prevented his going further and his two comrades who tried to continue the flight were forced down by engine trouble in the Bay of Bengal where they floated for three days on the wreckage of the seaplane before being picked up Several things have happened in aeronautics since 1922, notably an endurance record of 37 hours and a long distance flight of 2700 miles across the continent by the Air Service of the U S Army The airplanes that start across the oceans on the flight around the world will have embraced in their manufacture all the skill and experience learned on these record flights, so that dangers of failure will be reduced to a minimum It is generally agreed that the only thing that will prevent the success of the flight is the weather

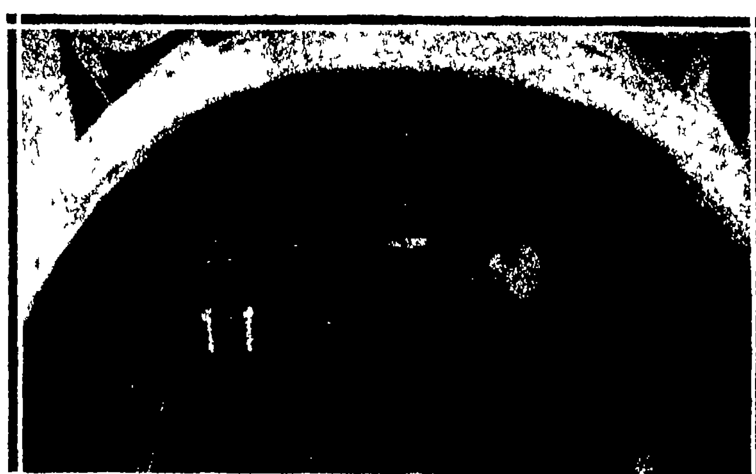
The airplane that will be used on the big flight is called the Douglass World Cruiser and designated by the symbol D-WC It measures 50 feet from tip to tip, 35 feet and 2 inches long and stands 14 feet high It is a biplane type and both wings are of the same span The wings are 7½ feet deep and the gap between them is exactly 8 feet the lower wing has a 2 degree dihedral but the upper one has none, and both are set with 3 degrees incidence or angle of attack There is no stagger or sweepback The total supporting surface is 700 square feet, which may be loaded up to about 15 pounds per square foot but normally it will be loaded at about 12 pounds The total weight of the airplane fully loaded and carrying pontoons for water landings is 9600 pounds but with pontoons off the weight is 1000 pounds less The wheeled landing gear weighs 364 pounds and when flying as a seaplane this extra weight may be carried as fuel or other supplies The useful load that can be carried is approximately 5000 pounds and if this weight be split up into a crew allowance of 300 pounds gasoline 3000 pounds oil 375 pounds and water, 84 pounds it will be seen that with the Liberty motor with which it is powered using 20 gallons of gasoline an hour a sustained flight can be made of 30 hours during which 3000 miles could be covered The speed of the plane has a range of 85 to 110 miles an hour No distances between stops however are so great on the route around the world that a sustained flight of this duration would be necessary so the fuel capacity has been cut down in the planes to 360 gallons or about 2160 pounds A special 1923 model Liberty motor will be used that can produce 420 horsepower but when it is speeded up it uses much more fuel than at normal speed which is around 1400 revolutions per minute An extra tank of water will be carried in the back part of the fuselage of the plane for use in emergency such as landing at sea and this water may also be turned into the engine cooling system if necessary

The four pilots and four mechanics chosen for this flight are men of unusual ability and they will be given the first trial of skill early in the flight, for the journey will cross the Pacific Ocean soon after the start The starting point will be Seattle, Washington, and from there it will lead up the coast of British Columbia to Prince Rupert, 650 miles from Seattle The planes will be refueled here and continue to Sitka Alaska, 300 miles further north From Sitka the route will lead to Cordova Seward, Chignik, Akutan, and Dutch Harbor The latter place is 2300 miles from Seattle and supplies of spare parts as well as fuel have been deposited there for use if necessary From here the flight will follow the Aleutian Islands to Attu, which is the furthermost island out in the north Pacific A landing will be made at Attu, and a full capacity of fuel taken on for the next stop will be Shimushu Island of the Kurile group belonging to Japan 860 miles to the southwest The flight could reach the Island of Mednyi off the coast of Kamchatka only 500 miles distant but it is thought the plane can go on further south without much greater effort The Island of Shimushu lies just off the southern tip of the Kamchatka peninsula and the aviators, after leaving Attu, will be able to reach the mainland of Asia or this peninsula, after about six hours of flying then the coast can be followed down to the Kurile straits which can be crossed easily and the island picked up The flight will continue through the Japanese islands down past Yokohama, Tokyo, Nagasaki and Chemulpo Next the coast of China will be touched and the aviators will proceed down the coast touching at Hongkong, then push on to Haiphong in French Indo-China From here the flight will go to Siam and a landing made at Bangkok, the capital Burma will next be entered and landings made at Rangoon and Akyab From Akyab, the route lies over Chittagong on the way to Calcutta, India

The round the-world plane carrying pontoons for water landing, in flight near Hampton Roads, Va.

It will be remembered that Malins and Macmillan, the two members of the Blake expedition, went down in their seaplane with a dead motor in the Bay of Bengal between Chittagong and Akyab They wallowed among the high seas and torrential rains until the water soaked plane finally overturned and floated with the pontoons just a little above the water The natives who occasionally passed them at some distance in boats gave them a wide berth, thinking they were the water devils of local tradition The diary written by the pilot, Macmillan, of this disaster is one of the strangest and most absorbing records ever written When we read of the despair that overcame them as ship after ship passed by without notice of how they fired their last round from the Very's signal pistol, of how the music known as the death song of the sirens, which shipwrecked sailors hear in the last hours of thirst and fatigue, assailed the ears of the two aviators—then we feel that the world must admire those men who attempt such daring feats in the cause of science The American aviators however, hope to cross the Bay of Bengal without such bad luck as their English brothers had and when they arrive at Calcutta several days will be spent in resting and probably overcoming their "sea legs."

At Calcutta, the pontoons will be removed from the airplanes and wheels put on, for the remainder of the flight to Hull England will be chiefly over land From Calcutta the flight will go to Allahabad, 475 miles northwest, in the interior of India, and from there to Delhi the capital of India While at Delhi, courtesies will be exchanged between the American officers and the English authorities. The flyers will not tarry long in India as an effort will be made to get through to the Persian coast before the heavy rains begin It was due to these rains, which rotted the rubber connections on the engine that Blake flew, that his expedition finally ended as it did Little pieces of rubber kept getting into the gas line and causing trouble If the Americans beat the rains, a great hazard will have been overcome



Cockpit of the Douglass plane, showing the instruments that keep the aviator's finger on the pulse of the Liberty motor

From Delhi to Multan the next stop of the flyers, 425 miles will be traversed. Care will be required on this particular trip as a course a little too far northward will take the planes over the forbidden city of Amritsar This city is the headquarters of the ancient religious order of the Sikhs. Amritsar, or the 'Pool of Immortality" contains the Golden Temple which has a copper dome covered with gold foil and it glitters in the sun with a brilliancy that dazzles the eyes. It should make a good landmark for the aviators and a good one to avoid, for within this Golden Temple is a copy of the Granth or holy Sikh bible, above which no living mortal may place himself—and live. An aviator who might fly over the Temple would get pretty short shrift from the local Sikh magistrates if they should catch him If the aviators land among these people, they will be able to identify them by their costume on which is carried five K's, standing for kes (uncut hair), kachh (short pants), kara (iron bangle) khanda (small steel dagger) and khanga (comb) The steel dagger is used to wrap and fasten their long hair, as well as for the other purposes of daggers. These Sikhs use no wine nor tobacco, so it will be quite

useless for the American aviators to expect to obtain cigarettes from them

If the flyers get through this land of the Sikhs safely they will land at Multan and "gas up," then proceed down the Indus River, skirting the great desert of Thar, to Karachi, on the Arabian Sea. From Karachi the flight will go to the little principality of Oman in southeastern Persia and a landing will be made at Charbor, the capital. The mountains rise to a height of 10000 feet in Oman and if the aviators enter the country from the north they will probably be required to fly through a great gorge known as the Wadi Thaika, or 'Devil's Gap.' From here the Arabian seacoast will be followed up to the strait of Ormuz, where a landing will be effected at Bunder Abbas From Bunder Abbas the Persian Gulf coast will be followed to Bushire, near the head of the Gulf From Bushire the flight will go to the head of the Gulf and pick up the Shat el Arab River which is formed by the junction of the Tigris and Euphrates Rivers a short distance from the sea This stream will be followed up to the fork of the two rivers named, when the right hand or Tigris stream will be taken and followed up to Bagdad in Mesopotamia Leaving Bagdad, the flyers will turn slightly westward and find the Euphrates River about 35 miles away, staying within sight of it and the western side until Lake Sabakha in northern Syria shows up as a landmark From this point the aviators will turn due west and locate a railroad along which they will fly toward the north until Aleppo is reached. From Aleppo the flight will go to Konieh which is in Asia Minor about 150 miles north of the Mediterranean Sea, and from there the route lies to San Stefano near the outskirts of Constantinople. From Constantinople the following places will be touched in turn Bucharest, Belgrade Vienna Strassburg, Paris and Hull or perhaps London. In England the wheeled landing gear will again be replaced by pontoons and the flight will proceed up along the coast of Scotland and on to Kirkwall in the Orkney Islands. From the Orkneys a flight of 275 miles will be made across the ocean to Thorshavn in the Faroe Islands. From the Faroes the compasses on the airplanes will be set so as to reach Iceland, 550 miles across the extreme North Atlantic The landing will be made in Iceland at Reykjavik the capital city

It should be stated here that the earth inductor compass will be carried on this flight and it is well that a compass better than the old type of magnetic needle can be used in these latitudes for the magnetic disturbances due to the aurora borealis throw the ordinary compass far off But even the earth inductor compass which is free from local disturbances and magnetic "memory," may be affected by strange shifts of the earth's magnetic field which some scientists believe take place in the arctic regions, especially during sun spot periods Every precaution will be taken, however, to prevent loss of direction in flight A radio compass direction finder is being tried out and may be used Observations will be taken from the planes in the air On the flight from Portugal to Brazil, Admiral Gago Coutinho, of the Portuguese Navy, found that he could take celestial observations, using the horizon of the sea for his base, and the error is not over one minute of an arc and this is almost as accurate as observations taken on board ships at sea Also Sir Arthur Brown, the English aviator who with Sir John Alcock made the first non stop flight across the Atlantic Ocean took an observation at 12 25 o clock at night using a sextant to fix his position after sighting the Pole Star through a drift in the clouds, and using the clouds as a horizon

The American aviators will not have much need for fear of missing the next landing place after leaving Iceland for the east coast of Greenland can scarcely be missed If a westward course is held There may be some difficulty however in hitting the exact point where the temporary base has been established This base has been arranged for by an advance officer who has recently returned from there and is located at the little town of Angmagsalik This town is the only settlement on the east coast of Greenland and is northwest of Iceland so the course the flyers will take from the latter place will bear to the northward in order not to miss the town Angmagsalik has 200 Eskimos and 6 Europeans in it and on such a vast coast line as Greenland it may not be the easiest place to locate especially since the coast is deeply indented with fjords some of which extend over a hundred miles inland. The east coast of Greenland is 1650 miles long and this lone settlement must be found by the aviators for supplies before proceeding to the next fuel base at Avigtut which is around Cape Farewell and on the west coast of Greenland Angmagsalik has a famous landmark near it however in the form of the great mountain peak of Ingolfs Field which stands six thousand feet high and can be seen for many miles at sea The distance between Iceland and Angmagsalik is 500 miles and it is very possible that this mountain will be seen by the aviators after the first three hours at sea, provided they maintain a fairly high altitude This mountain peak is undoubtedly the Blagsark or Blue Shirt, spoken of in the Norse legends which was used as a landmark by the early Vikings who settled Greenland in the ninth century

Avigtut on the west coast, is a fair sized town for that country and a steamer for an ore company in the United States makes two trips a year to it. Arrangements have already been made for the aviators when they reach there on the homeward stretch Ice-free land can be found as far as 80 miles inland on this west coast of Greenland near Avigtut The Gulf Stream passes up along the coast near this town and warms the country fairly well The winters are no colder here than in Sweden or Norway and rarely does the temperature drop below that of a cold winter day in North Dakota or Montana in the United States

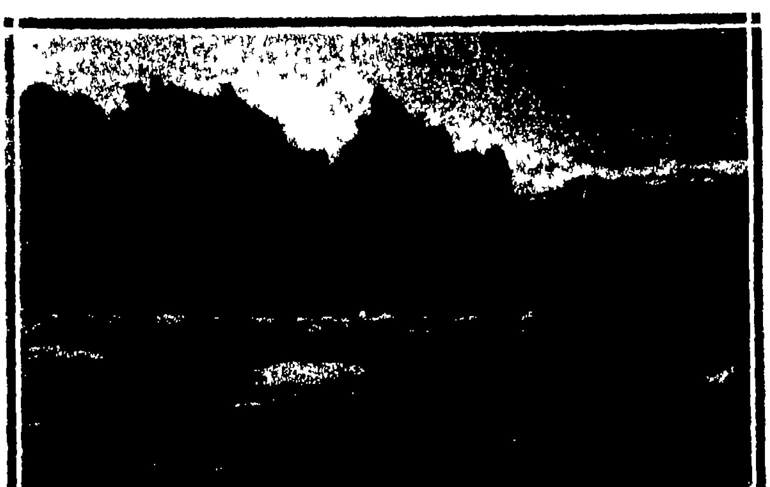
The next leg of the world flight will be rather long From Avigtut the route lies toward Labrador where a landing will be made at Indian Harbor 700 miles away Very little time will be spent here as Labrador is much colder and the weather more uncertain than that of south Greenland The next flight will extend southward to Mingan Quebec thence to Quebec Quebec thence to Montreal and then to Keyport New Jersey At Keyport the pontoons will be removed from the airplanes and wheel landing gears again put on Then the flyers will come to Washington, D C, and after a short rest proceed to Seattle the place where the flight started

There are no scientific reasons why the flight cannot be made with little difficulty No leg of the journey will exceed 800 miles and this is easily within the fuel capacity of the planes cruising distance If all those little parts of motors and airplanes will hold together as they should and as the engineers expect them to do, the flight will indeed be a triumph of science in the onward struggle of mankind and the way will have been opened for the establishment of great inter continental air routes which are sure to come The idea of inter-continental air travel is the underlying cause for the making of this long journey In an official announcement of the World Flight the War Department stated the purpose of the flight in these few but sufficient words

To demonstrate the feasibility with which aerial communication may be established between the various continents and to obtain desired information concerning the operation of present type aircraft in various climates of the world '

Juneau, Alaska, which the round-the world winged voyagers will pass early in April if they start on schedule

The 29,000-mile route laid down for the round-the-world flyers. A few changes have been made since this map was adopted, notably the substitution of the island of Shimushu as the first landing place in Japan

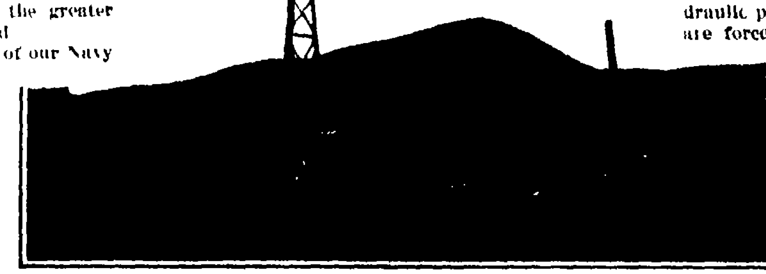


Vast glaciers like this will mark the scenery as the aviators fly over the cold and bleak Arctic regions

Teapot Dome

Some Physical Facts in the Naval Oil Reserve Problem

IT WAS inevitable that when the advantages of oil as a fuel for merchant ships had been established, its use in naval ships would follow. For, in addition to the gain in economy there would be certain strategical advantages due to the ease with which it could be stored, and the greater speed with which a fleet could be refueled.



First gusher drilled in Salt Creek Field. It was this well which led to the development of Salt Creek, which in many respects is considered by the U. S. Geological Survey to be the world's most remarkable oil pool. It adjoins Teapot Dome

When it was decided to change the ships of our Navy from coal to oil burning, and to design all future ships for the use of oil, the question at once arose as to future oil supplies. It was realized that these must be absolutely assured. Furthermore not only must there be sufficient oil but it must be stored in large quantities at certain bases so located around our coasts and at outlying possessions that the fleet, wherever it might be operating would be within easy steaming distance of the supply stations.

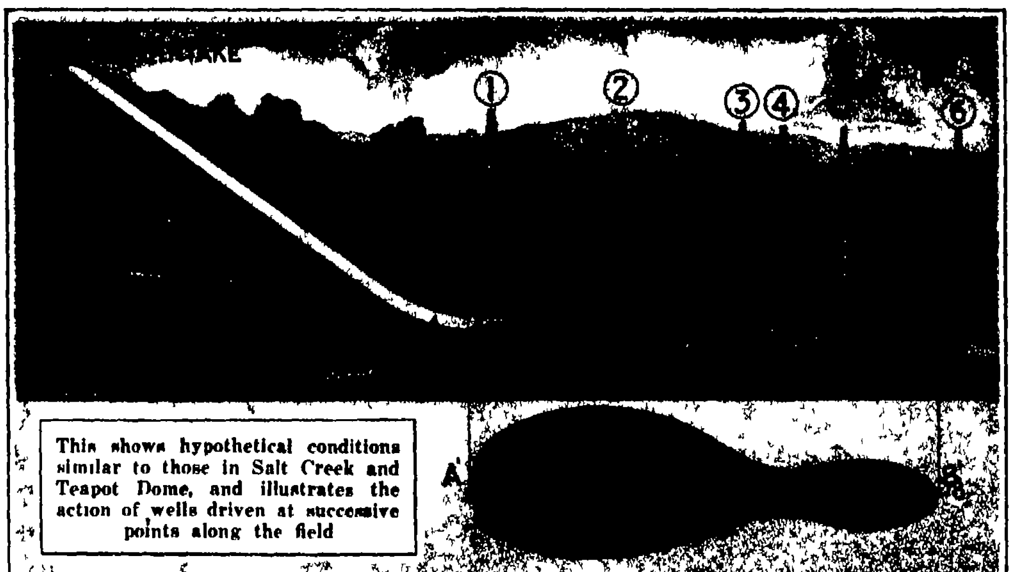
In view of the feverish activity with which the oil interests were taking the oil out of the ground it was realized that unless some provision were made for the future, the Navy might conceivably be confronted with an oil shortage or might have to pay a price for its oil that would be a heavy drain upon the annual appropriations made by Congress for running the Navy.

Hence it came about that the Government set apart certain rich oil lands known officially as Naval Reserves 1, 2 and 3, which were withdrawn from public entry and reserved strictly as future sources from which the oil could be drawn as it was needed.

Naval Reserves No. 1 and No. 2 which adjoin each other are located in California about 55 miles to the east of San Luis Obispo. No. 1 contains 38,000 acres and No. 2 has 29,541 acres or a combined total of 67,610 acres. These properties are of far greater value than Reserve No. 3 (Teapot Dome) which covers 9481 acres.

Reserve No. 1 was withdrawn from mineral entry September 27, 1909. It was set aside as a Naval Reserve September 2, 1912. On April 25, 1922 a small part of it was leased to Doheny and on December 11, 1922, all of the public lands in this reserve were leased to the same man.

Reserve No. 2 was first withdrawn from public entry on September 27, 1909. It was set aside as a Naval Reserve on December 13, 1912.



This shows hypothetical conditions similar to those in Salt Creek and Teapot Dome, and illustrates the action of wells driven at successive points along the field

Reserve No. 3, the now famous Teapot Dome reserve, like the other two is known to be very rich in oil. It is situated about 30 miles north of the town of Casper, Wyoming. The Reserve was first withdrawn in part from mineral entry on September 27, 1909. On June 18th of the following year there was another partial withdrawal. It was set aside for the Navy on April 30, 1915 and was finally leased to the Mammoth Oil Co. on April 7, 1922.

By the courtesy of Mr. G. O. Smith, Director of the Geological Survey (Department of the Interior) we present two plats showing the location and boundaries of these reserves and a vertical section through Teapot Dome. These were prepared for the SCIENTIFIC AMERICAN by Mr. K. C. Heald, Geologist of the Geological Survey. The last named authority has also had prepared for us the accompanying hypothetical cross section for the purpose of illustrating the *comparative* effectiveness of wells variously located on an anticlinal oil pool where the oil and gas are under heavy hydraulic pressure—conditions which broadly represent those to be found in the Salt Creek and adjacent Teapot Dome fields.

Before going any further into the meaning of these cross sections let us consider a few facts about petroleum, as it exists in the ground, before its age-long rest and equilibrium are disturbed by the entering oil drill.

Petroleum is always found as a liquid. Its more volatile parts may be taken into the air by evaporation or into dry clays by absorption, but the solid or semi-solid substance that remains is known as bitumen. In color the oil is generally some shade of brown. It may also be yellow or green and even, in exceptional cases, coal black. Roughly speaking, the color indicates its value, oil of the lightest color being the most desirable. Another characteristic is its viscosity or "stickiness." Some petroleums flow as freely as water; others look and flow something like molasses. A third differing characteristic is its weight. Ordinarily it will float on water, but a few rare oils will settle sluggishly to the bottom of a water-filled vessel. Its weight compared with an equal volume of clear water at the same temperature is known as its specific gravity, and the lighter the oil the higher its value, for the light oils contain a higher percentage of gasoline than the heavy ones.

Petroleum is contained in the rocks that underlie certain parts of the country, and generally it is found in beds of sand, sandstone or limestone. Associated with these beds are invariably shale and clay, and we are told by Mr. K. C. Heald in a statement from which these notes on petroleum are gathered that a region without shale and clay has small prospect of containing commercially valuable accumulations of petroleum. Now in every oil field a little oil is scattered so generally through the oil bearing beds that a well reaching these beds at almost any place is likely to get a faint showing.

Oil in paying quantity is found only in small "pools." In these pools practically every tiny opening in the oil bearing bed is filled with oil or with the gas that generally accompanies it. Where the oil bearing beds are arched or bowed upward, the oil has in many places formed pools at the tops of the arches. The ideal form for an oil bearing bed or set of beds is dome-shaped like a basin or a set of basins turned upside down, but in many places simple arching is sufficient to afford a gathering ground for oil. A "terrace" on which the dip or inclination of a bed is interrupted by flattening out into a step, is moderately favorable for the accumulation of oil. This will be understood if we remember that the oil bearing strata are under hydraulic pressure and that the oil and gas being lighter are forced upward and held by this pressure within these domes or against these terraces.

The depth at which oil may be found is limited, apparently, only by the depth to which drilling can be carried. In some fields productive oil wells have been found at a depth of only 100 feet. In other fields most of the wells are over 3000 feet deep, and some go down to more than 4000 feet. Petroleum may perhaps be obtained from depths of 5000 feet or more, but the cost of drilling would not today be justified by the probable returns on the investment.

Most of the wells drilled within the limits of an oil pool yield enough oil to make them paying investments. The pools vary greatly both in size and in yield. Some cover only an acre or two of land; others may be as large as five miles wide and twenty five miles long, although such pools will include barren or dry spots. The average pool is about 2½ miles long, by 1¼ miles wide. A pool production of less than 4000 or 5000 barrels of oil could scarcely be dignified with the name of pool. On the other hand the output of a large pool is measured in millions of barrels. For a period in 1916, the Cushing field of Oklahoma yielded more than 2,000,000 barrels a month. The largest well in the United States produces less than 100,000 barrels a day, but some single wells in other countries have yielded between 150,000 and 250,000 barrels a day.

Now let us turn our attention to the cross-sectional drawing showing hypothetical conditions which conform in general to those in the Salt Creek and the adjacent Teapot Dome fields. Here we have two domes with a depression between, the smaller one corresponding to the Naval Reserves. Six wells are shown along the axis of the two fields reaching in every case the oil bearing stratum.

Well No. 1 would yield oil for a short time drawing part of it from the left flank of the large dome and part from the narrow band of oil to the left of the well. Water would replace any oil taken out, so that after a short time the well would produce only water.

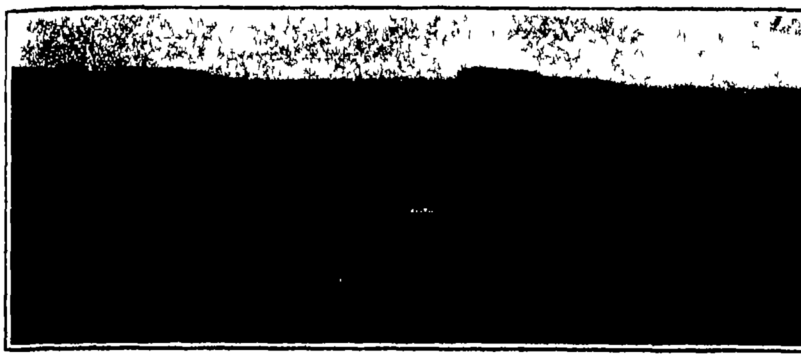
Well No. 2 is in a particularly effective position. It would drain oil from the top and sides of the dome, and the encroachment of water on the flanks of the domes following the extraction of the oil would not affect this oil until a long time had elapsed.

Well No. 3 would be moderately effective in draining oil from the pool, drawing most of it from the right flank of the large dome but a little from the sag or saddle between the two domes. However, as oil was withdrawn from the pool, and particularly through well No. 4, water could come in from the sides of the domes and fill the sag or saddle, forcing well No. 3 to drain all its oil from the large dome.

Well No. 4 is poorly located for large and lasting production, for the withdrawal of a comparatively small amount of oil will permit the water that surrounds the dome to creep into the saddle and fill the sand surrounding the well, so that the well will yield not oil but water.

Well No. 5, like well No. 2, is excellently located to yield oil for a long time.

Well No. 6 will obtain no oil, even though suction is placed on it and great volumes of fluid produced, for



Early wells at north end of Salt Creek anticline

Pool of oil from the first Salt Creek gusher

water moves more readily through sand than does oil and the supply of water is inexhaustible

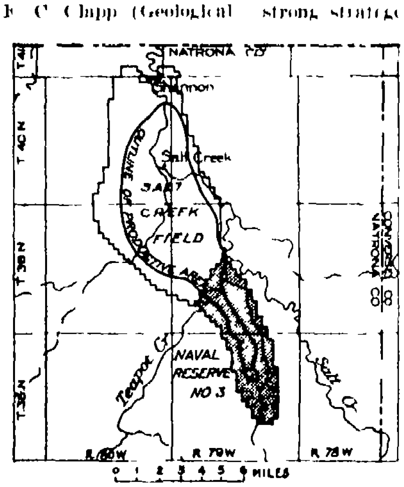
Now consider the drawing showing an actual cross-section through Teapot Dome and Salt Creek It is taken from a map by Fisher & Lawrie prepared for the Midwest Refining Company The cross section runs approximately north and south The attitude of the top surface of the First Wall Creek sand is determined from the map and the relation of the Second Wall Creek sand and the approximate dips of the faults are taken from the testimony of F C Clapp (Geological report) of the Senate Committee on Public Lands

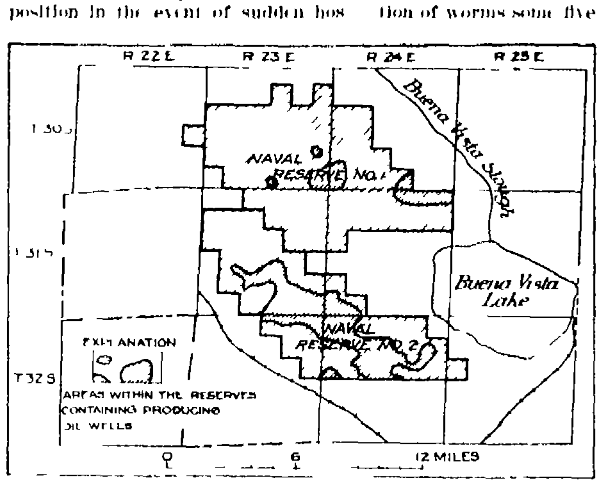
Now this cross section answers the question (a very important question in its bearing upon the present controversy) as to whether Teapot Dome was threatened by wells which were being drilled in the Salt Creek property for it will be noticed that Naval Reserve No 3 includes not only all of Teapot Dome but also the south end of the Salt Creek anticline or arch Hence, wells driven north of the Naval Reserve boundary would drain oil from the Salt Creek anticline and not from the Teapot Dome

Let us now consider the disposal which the Navy has made of its oil reserves It has been pretty well established that there was a division of opinion among the Naval authorities as to whether the Naval Reserve oil was being drained away by wells sunk on the property adjoining these reserves Mr Denby the Secretary and Chief Engineer Rear Admiral Robison believed that these oil fields were so endangered So, as the public already knows the fields were transferred back to the Interior Department and contracts were made with certain private interests who agreed to take out the oil at a royalty refine it build extensive tankage facilities at certain specified Naval bases, and store the fuel oil therein in the possession of the Navy and ready for Naval use

Mr Denby who still believes that fuel oil in tanks is a better asset than crude oil in the ground sent in his resignation to the President who accepted it with the statement you will go with the knowledge that your honesty and integrity have not been impugned Rear-Admiral Robison one of the ablest chief engineers who ever held the position recently assured the writer that nothing had happened to change his belief that the taking out of the oil and its storage not merely saved the oil for the Navy but had put the Navy in a strong strategetic position in the event of sudden hostilities calling for large available fuel oil supplies

In this connection it should be noted that the British Admiralty who are credited with farsighted vision in Naval affairs have expended $35 000 000 since the war in the construction of tanks at fueling stations and the purchase of oil and they are spending about $5 000 000 yearly for Naval oil and the extension of fueling facilities The policy of our Navy decided upon in 1919 contemplated the erection of supply tanks at Pearl Harbor in the Hawaiian Islands at Manila Philippine Islands and at selected bases both on the Atlantic and Pacific Coasts This would have provided the Navy with one year's supply At Pearl Harbor there would have been 2 700 000 barrels and this contract is about 60 per cent completed One million barrels were to be placed in tanks in Southern California, and 3,000,000 barrels along the Atlantic Coast





Left Plat of Teapot Dome which is shown shaded with Salt Creek Field adjoining *Right* Plat of Naval Reserves No. 1 and No 2 open shading shows the reserved territory close shading the areas of producing wells

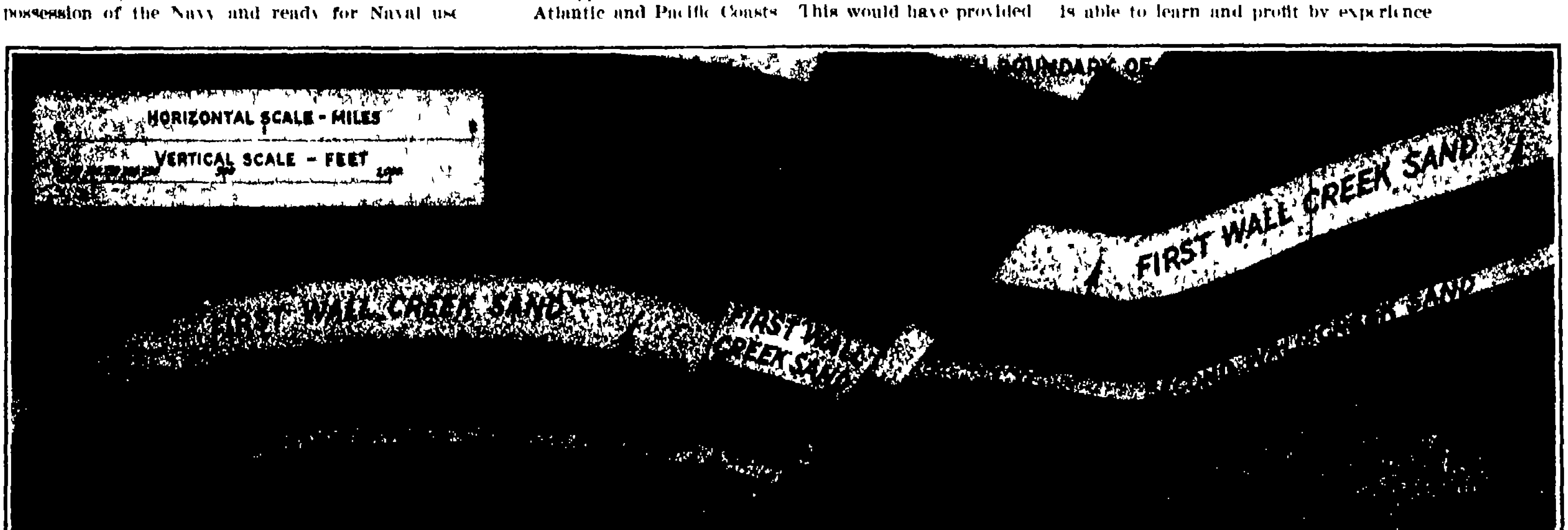
The geography of the naval oil problem

How Earthworms Learn

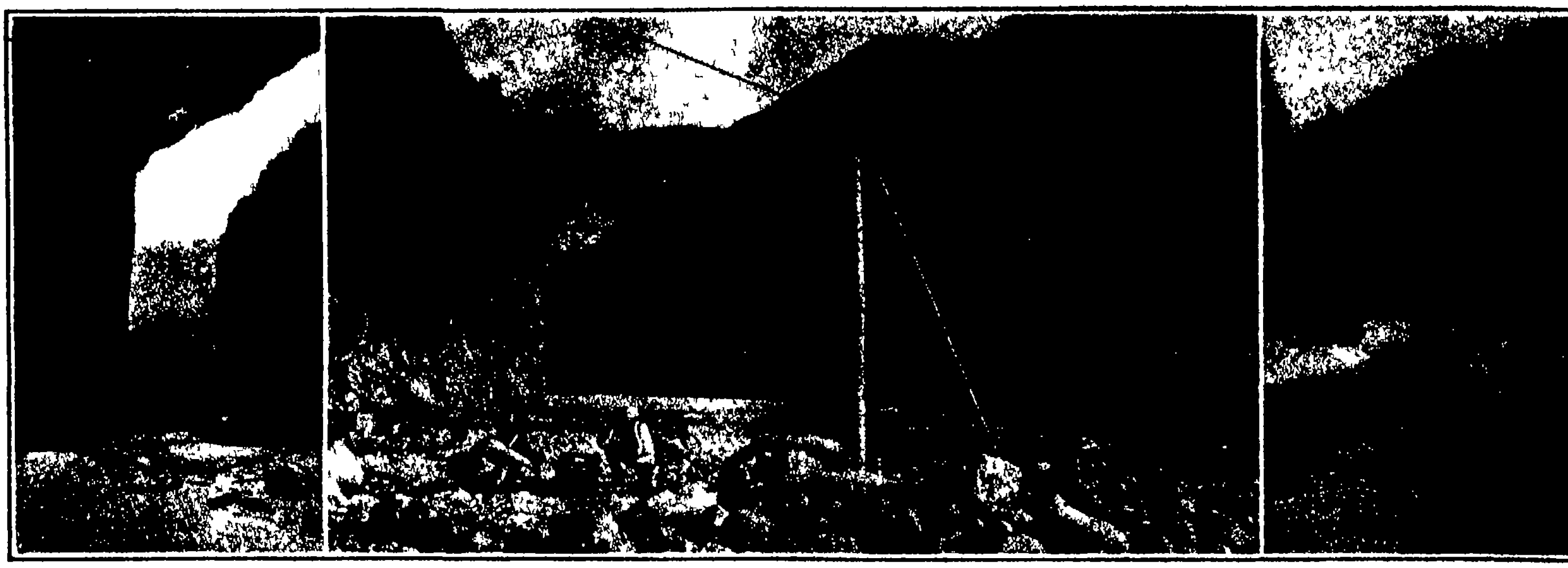
EARTHWORMS have memory and may be trained, it has been shown by Prof Heck of the University of Prague as the result of experiments with a collection of worms some five hundred in number The worms were introduced into a passage shaped like a capital T and carved from a block of wood which was covered with a glass plate so that the movements of the little creatures might be observed When they came to the junction about half of them turned one way and half the other

Then the apparatus was so arranged that those worms that took the left hand passage received a mild but presumably disagreeable electric shock At first the worms did not know just what to make of all this but after they had all been through the experience about two hundred times they nearly all took the right hand turn When the electrodes were then moved to the right hand passage the worms learned to shift to the other passage after only 60 trials, evidently showing something more than the mere operation of chance

In the human sense earthworms have no brains their nervous systems consist of a series of little ganglions, or nerve centers on the under side of the worms and connected with each other by nerve fibers If the worms were cut in two the fragments still showed the ability to distinguish between the safe and the unpleasant road to travel indicating that the earthworm remembers in every one of its ganglions and that it is able to learn and profit by experience



Cross section through Teapot Dome and southern portion of Salt Creek anticline This shows the upper, water bearing sand, the lower oil bearing sand, and the three faults that have occurred Note that wells driven north of the Naval Reserve boundary would drain oil from the Salt Creek anticline but not from Teapot Dome



Left: View through a side canyon into the great Marble Canyon *Center:* Col. Birdseye hears that the Washington ball team won a game—via radio. *Right:* Engineers at work in Marble Canyon

Running the Rapids of the Grand Canyon

An Exceptionally Hazardous Piece of Surveying and Mapping by Uncle Sam's Topographers

By Guy E Mitchell
U S Geological Survey

THE great project of accurately surveying and mapping the Colorado River from its source to its mouth has been completed by topographic engineers of the U S Geological Survey Combined with this has been a geologic examination of the rock structure of the canyon so that for a distance of 1400 miles during which the river falls some 14000 feet Uncle Sam now has exact data of river gradient depths of the main canyon and the side canyons, and the character of rock formations with special reference to the feasibility of dam sites for the control of our second greatest river which has cut out the most stupendous gorge in the world

The most difficult and dangerous portion of the project, some 300 miles including all of the Grand Canyon was left to the last and this has recently been completed under the leadership of Colonel Claude H Birdseye Chief Topographic Engineer of the Geological Survey Entire success attended this hazardous undertaking due largely to the care taken in picking experienced well seasoned men to whom hardship and adventure are simply part of the days work The party consisted besides Colonel Birdseye of E C LaRue hydraulic engineer who has for years made a great study of the Colorado River R W Burchard topographic engineer who had already surveyed the lower stretches of the river, Herman Stabler hydraulic engineer who made a partial descent of the river last year all of the Geological Survey R C Moore State Geologist of Kansas, who for two years has been making geological investigations in Utah and Arizona, Emery C Kolb who in 1911 with his brother made a boat trip through the Grand Canyon to the Gulf of California Lewis R Freeman of Pasadena California a well known explorer writer and boatman Leigh Lynt of Weiser Idaho, and H E Blake Jr, of Monticello Utah two husky youngsters with two years experience in boating the rapids of the Colorado Frank B Dodge of Honolulu as skillful a boatman and expert a swimmer as any native Hawaiian and a cook

The trip was made in four small heavy wooden boats which carried all the supplies and instruments of the party and also, except at the portages the men themselves The party had also a special radio receiving set and complete photographical equipment While this was not the first trip down the Canyon Major J W Powell in 1870 having disproved the Indian stories of giant waterfalls and underground channels, impassable whirlpools and like terrors, the trip was filled with adventures and dangers a single day's experience of which would have remained forever in the memory of any tenderfoot who might have been along During the period of preparation for the trip many applications from adventurous spirits desiring to accompany the party, were firmly refused. Only proven and capable men equal to any emergency were wanted for the great adventure was a simple business undertaking to carry through an accurate survey of the Canyon to locate sites at which dams for irrigation and power development might be built to utilize the vast volume of waste waters of the Colorado, and to insure flood prevention Colonel Birdseye kept daily notes of the voyage and since his return he has given several lectures describing the trip Both his diary and his talk seem somewhat commonplace accounts of an unusually rough river trip but it is easy enough to construct between the lines an adventure which if undertaken by less experienced explorers and resourceful men would have ended in disaster and failure a dozen times. Day after day the tide of the great river swept the men into just one danger after another—rapids, whirlpools frightful swirls rapids and rapids again, racing their boats between almost sheer or overhanging walls thousands of feet high

The party started down stream from Lees Ferry, Arizona on August 1 and for 3¼ months, without stay or rest, they battled among the waters for a total distance of nearly 400 miles. A few examples of the high spots' of the trip may give a slight idea of the things encountered On August 8 for instance the party portaged the boats past Soap Creek rapids These rapids have never been safely run by any party and here the Kolbs in 1911 upset both their boats "It was man killing work says Colonel Birdseye, "to portage these heavy 900 pound boats across immense rocks and perhaps we might have come through safely without portaging, for we later ran worse rapids, but it did not seem wise to take the chance so early in the trip The next day we reached a wicked looking rapid, running between vertical cliffs directly from the boiling water, with no foothold for a portage and no chance even to look the rapids over and form a plan for running them We called them Sheer Wall Rapids but we ran them safely, although soaked to the skin Such rapids we always ran with the boats stern first We slipped on cork life jackets with Kapok collars and except the boatman, lay face down in the cockpit of the boats, clinging hard to the life lines stretched across the decks The waves seemed mountainous and to some of us our first ride of this kind was a genuine thriller, but we afterwards became so used to riding rough water that we vied with one another to make the plunge with a lighted pipe or cigarette and not lose the light"

In running Boulder Rapids one of the boatmen Blake, was thrown out of his boat by the tremendous force of the waves and turned a complete somersault going out of sight beneath the muddy swirl, but he bobbed up like a cork outswam his boat and climbing in fought on through the rapids.

The dreaded Sockdologer Rapids was reached the latter part of August The fall is 19 feet, mostly in the first hundred yards, and the waves measured a full 20 feet from trough to crest—something of a wave in a river running faster than any mill race. The next morning the boats plunged into Grapevine Rapids, described as a regular terror which, besides running like the tail races of Hades, has more than its share of big jagged rocks. Near Spectre Chasm the boats shot into a small rapid where, according to Colonel Birdseye, the party was in greater danger than at any other point on the trip The channel here is shaped like a letter S and the lashing current drove the boats upon a large mass of wicked rock that lies midway of the rapids. Two of the boats missed this rock very narrowly and one struck it lightly Burchard pushed against the rock with his hands and kept the boat off, and Lynt said he had scraped the flies off of one side of his boat and hoped that they would not annoy him further

In a dangerous rapid below Kanab Creek, Kolb ran first and was drawn into a great swirl, where his boat turned upside down and he disappeared. Dodge courageously plunged into the torrent and caught the boat at the foot of the rapids. It looked as if Kolb were gone but he

The boat "Marble" of the Geological Survey Grand Canyon expedition beached for repairs

popped out from under the cockpit of his boat almost unharmed, though he coughed up some water. It was all over in a minute and forgotten, with only a couple of passing yells and grins of congratulation.

At the mouth of Tapeats Creek, on September 8, the radio was set up for the first time in a week and KHJ at Los Angeles came in clear. The walls of the Canyon are here not far short of a mile high, but the party heard that a great earthquake had occurred in Japan and that the Washington Baseball Club had won a game—despite the prediction of radio experts that it would be impossible to hear anything in such a deep canyon. At Fishtail Canyon, on September 10 the party photographed the eclipse of the sun which was there 75 per cent of a total eclipse.

Amid the excitement of running rapids and the men's dare-devil defiance of the swirling waters of the Canyon the scientific members of the party worked methodically on the main purpose of the expedition. At numerous points the surveying instruments were set up, photographs were taken and calculations were made in furtherance of the larger ends in view.

One of the unexpected incidents of the trip was a big and unseasonable flood. Camp had been made September 18 on a small sandbar below the famous Lava Falls, when the river soon began to rise. By 8 o'clock the boats were pounding badly and it became necessary to find a safer place for them. Two of the men therefore pushed off downstream in one of the boats with lantern and flashlight and in about an hour returned overland to report that they had found a shelving limestone shore up which the boats might be dragged. No one expected a rise of more than 5 or 6 feet but the boats were nevertheless run down, and as it turned out it was a sleepless night for the men, for the water rose rapidly, and they were kept busy dragging one boat after another out of the water to higher places. The cook went to bed 10 feet above water but was flooded out at midnight. Colonel Birdseye lay down at 2:30 in the morning on a rocky slab 20 feet above low water but two hours later was awakened by waves lashing the rock. By morning the river had risen 16 feet, a sullen, surging flood and it continued to rise all day reaching a peak of 21 feet. Measured in volume the excess flow was estimated at 100,000 cubic feet of water running by each second. This flood gave rise to sensational newspaper reports that the party had been lost.

One of the incidents of the trip was when Burchard, the topographic engineer, fell on the rocks and broke a rib, but insisted on continuing his survey with his side bound up with surgeon's plaster. With the exception of the first day's work below Lees Ferry he had made the entire survey of the river, and he wanted to carry the line down to connect with his old work just above the mouth of the Grand Canyon. He is responsible for the entire survey through Marble, Grand, Boulder, and Black canyons a distance of over 400 miles. In spite of the rib, he was successful in his effort, and was able to finish the work which he had started several years before.

From the juncture of Diamond Creek Canyon with the main gorge the boats plunged through rapid after rapid. One of the worst was Separation Rapids, the place where three members of Major Powell's first expedition left the canyon in discouragement and apprehension, and were soon afterward killed by the Indians, Powell and the others of his party going through safely.

The rapids here have a short fall of nearly 20 feet, and they looked wicked and dangerous. The sheer walls left no chance to pass around them, so everyone had a free ride on the boats. Kolb, Blake, and Lynt ran their boats safely but the deck loads made the boats top heavy and caused them to dance about in the torrent like corks even after the cockpits were filled with water, giving the passengers the roughest ride they had had since the Sockdologer. Freeman ran last with LaRue and Moore clinging to the hatches. These three surely must have had one of the thrills of their lives, for the huge twenty foot waves tossed the boat in the air, and when it came down bottom side up they were thrown out between the boat and the rocks on the bank. LaRue in particular narrowly escaped being crushed to death or badly cut as the torrential water rolled him about between the sharp rocks and the heavy boat.

Freeman had dived clear of the boat and had come up a few yards from it where he caught a rope. Blake and Dodge pushed out in their boat to render assistance. Dodge grasped the painter and helped to haul LaRue aboard, Freeman and Moore holding hard to the upturned boat, which was towed out of the surging torrent into quieter water and righted. Moore and Freeman seemed really to enjoy this exciting experience but nevertheless decided that one trial was sufficient. LaRue admitted without hesitation that he didn't like it at all.

While the success of the work of the expedition is to be attributed largely to the able leadership of Colonel Birdseye, the persistence of the indefatigable Burchard and the skill and good judgment of the head boatman Emery Kolb in piloting the boats through the savage waters of the Canyon, it can be seen that all of it was real men's work.

Lava Falls at the height of the flood. The water reached a peak of 21 feet. It was estimated that 100,000 cubic feet of water ran by each second

Col. Birdseye and his party of surveyors and engineers who made the Colorado Canyon trip

Painting the Cylinder Head to Increase the Power

AN interesting invention for the improvement of automobile performance based on an entirely new principle as far as the automobile industry is concerned has now been perfected and brought on the market. While almost all inventors have tried to improve the mechanical features of an internal combustion engine, this invention touches the basic principle of the internal combustion engine, namely, the chemical process in the combustion of the fuel.

The reader will be familiar with the phenomena of catalytic action, involving the use of a catalyst, frequently a metal in a finely divided state, which accelerates the rate of a chemical reaction by its mere presence, without itself undergoing any permanent change. The most familiar applications of catalytic action are the gas mantle, the manufacture of sulfuric acid by the contact process, the hardening of oil and fats, and the manufacture of ammonia from atmospheric nitrogen. The latter process acquired international importance during the war as it enabled Germany to offset to a large extent the lack of imports of Chili nitrates in the manufacture of explosives.

This principle has been applied by Dr. E. Sokal to the acceleration of combustion in internal combustion engines, thereby effecting a more complete as well as a more rapid burning of the fuel, thus increasing the power and flexibility of the engine and leading to an appreciable fuel economy due to the possibility of using leaner mixtures and the reduction of carbon deposits.

The invention is remarkable for the great simplicity of its application and working. The catalytic agent is mixed with a special binder and applied in the form of a paint to the cylinder head, where it remains unaltered for a great length of time. In fact cars that have been so prepared have run 15,000 miles and more without any appreciable lessening of the beneficial effects of the catalytic agent.

Very exact laboratory dynamometer tests, as well as extensive road tests have been made by some of the leading authorities on automobile engineering, by several large automobile manufacturers, as well as by the Bureau of Standards. In every case the result has been satisfactory. The effects of the catalytic agent differ of course with different types of engines. It has shown the most striking results with the lighter and more popular cars. In one case, the average increase in mileage obtained in eleven road tests was 30 per cent.

In the course of his investigation the inventor has incidentally cleared up a very interesting point in automobile engineering. The question of detonation in the internal combustion engines has greatly puzzled the experts and the generally accepted theory was by Mr. Midgley who tried to explain the detonation by too rapid combustion. From Dr. Sokal's investigations it seems now clearly established that detonation is caused by the decomposition (cracking) of the very complex hydro-carbon molecules of the fuel. This decomposition would of course tend to increase the number of molecules the impact of which against the piston head would then cause the phenomenon of detonation. The accelerated combustion produced by the catalytic agent naturally tends to obviate this

A Theater Without a Stage

The Whole Building Given Over to the Play with the Audience Part of the Scenery

By Albert A Hopkins

WHEN a theater becomes a conventual church when the orchestra and choir go up in the balcony, when the curtain is thrown away, when audience and actors mix—then we certainly have an upset theater to say the least Yet all this happens eight times a week at the Century Theater New York where Max Reinhardt has staged The Miracle for Morris Gest

First, let us say that the play is wordless, which eliminates to a large extent one of the most important means of expression of the actor Then in the dim religious light much of the facial expression is necessarily lost Therefore it is necessary to make this up by other methods There are certain old stories and legends like the Ring which appear and reappear and are never entirely dead One of these the story of the Virgin and the Nun comes around in one form or another as the 'Soeur Beatrice of Maeterlinck 'A Ballad of a Nun' and others The compelling cause of the spectacle was the fact that they needed at Olympia in London a performance which could be visited by thirty thousand people daily Of course the spoken drama was impossible and The Miracle was the result The author was Karl Vollmoeller the composer was the erudite Prof Humperdinck the talented creator of 'Hansel and Gretel and Reinhardt made up the balance Since 1911 this production has had a most profound influence upon the arts of the theater especially in England where something was needed to shock the theater out of its time-honored groove From London The Miracle spread all over Europe and there were seventeen producing centers besides a travelling company In New York 'The Miracle was scheduled for Dec 9 1914 and everything was in work when the thunderbolt broke so it was not until Jan 15 1924 that the New York premiere came off

A pantomime cannot be produced like a play on any stage independent of its size and shape and without consideration of the size and shape of the auditorium Space music and acting must be thoroughly correlated must become an indivisible unit a living organism with its own laws and necessities The play the music and the acting in any pantomime are algebraically speaking functions of the space The slightest variation of any distance necessitates a corresponding change in the music in the movements of the actors in the arrangements of the producer The Century Theater was cast in a glorious mold, the vast stage lending itself to massive scenic productions nevertheless in the front of the house four hundred seats had to be scrapped to allow for the orchestra and choirs in the balcony and to bring the action well into the orchestra

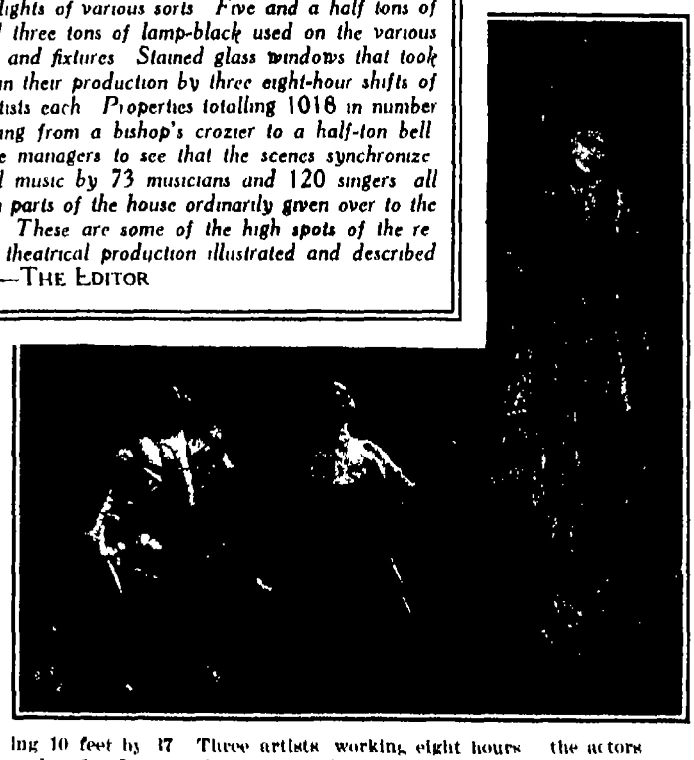
One enters the dimly lighted church for such it has really become and one is assisted to one s seat by ushers disguised as lay sisters One would almost think one was in some fane in Rouen or on the Rhine the glorious arches tall columns and stained glass windows at sides as well as in the sanctuary help the illusion Presently the aged sacristan comes in and the lone red sanctuary lamp is augmented by the lights on the altar The far away bells begin to ring It is the Angelus and the choir and the people in the production join in the grand old Latin prayer The procession comes right up the aisles past the audience with candles crucifix, etc and with the clergy in proper ecclesiastical vestments A young nun receives the veil from the Abbess and is then entrusted with the keys of the church Her special duty is to watch a miracle-working statue of the Virgin and Child She finally revolts at the discipline and implores the Virgin to release her from her vows and let her become once more of the children of the world and as she commits a great sacrilege by tearing away the Child the altar opens and she joins her lover The statue of the Virgin then comes to life and she assumes the habit and duties of the nun After seven years the recreant nun having passed through all phases of life as portrayed in the wonderful scenes eight in number, comes again into the cathedral and the materialized Virgin assumes her discarded robes and crown and once more becomes immobile The erring nun puts on her vestments which the Virgin has left at the base of her throne and as if the bitter taste of life had been only a dream she rings the Angelus bell and the sisters come in only to find that a miracle has been performed In an ecstasy of religious fervor the statue is carried toward the altar and is raised on high in a gorgeous scene which ends the performance and the audience file out without applauding

This is a very meagre description of what happens and one must see it to understand the story We can at least with the aid of our detailed drawing tell how it is managed On the stage proper is erected a horseshoe shaped platform corresponding to the apse or circular end of a church and covering 6500 square feet Twenty huge columns 60 feet high end in a vaulted ceiling The columns and ceiling weigh over twenty five tons and are fixed There are eleven solid wings as side scenes are called each 13½ feet wide by 60 feet high The ordinary wing measures 4½ feet wide by 16 feet high There are six cathedral stained glass windows measuring 10 feet by 17 Three artists working eight hours a day for 5½ months, painted the models for these windows Behind these huge wings are nine groups of vaulted chapel columns rising 50 feet Thirteen ornamental iron gates are also part of the cathedral scheme The altar occupying the center of the stage covers an area of 240 square feet and is 37 feet high The entire stage setting is masked at the rear by a cyclorama of 14 000 square feet of black felt, the largest ever made and sufficient to cover 10 city lots The floor covering is 6700 square feet of linen duck over which is an equal amount of asbestos slate to give the required antique floor effect of a cathedral The proscenium opening is constructed in a series of three arches To build this required 15 000 square feet of molding 5000 feet of lumber 10 barrels of plaster and 20 rolls of wire mesh To the right of the proscenium arch is a turret 60 feet in height inside of which is incorporated a flight of 60 steps which is used by only one character in the play and that for less than five minutes

The wings the altar gates and the columns in the vaulted chapel are heavily counterweighted They all rise at once and are hauled up out of sight by four electric motors on the "gridiron' 116 feet above the stage Three motors actuate two steel shafts 75 feet long on which are secured 27 drums hauling a weight 24 300 pounds a distance of 80 feet in a short time One can hear the "quick change' but cannot see it as the stage is in total darkness which is made perfect by a smoke screen In the last scene the cathedral is once more restored as quickly as it was destroyed by a reversal of the operation

The chief electrician has a most difficult job as the least bungling would produce dire confusion He sits in the top gallery in the center with six huge spot lights to the right and left in the hands of expert operators and watch in hand follows the minutest turn of the drama enacted a hundred feet below With telephone he gives the quick and decisive orders which are received by the electricians at the enormous switch boards in the wings Here with the aid of switches and dimmers the slightest orders are translated into surging or ebbing flows of light In addition to the spotlights in the top gallery, there are in the two lower balconies 150 one-thousand watt spotlights which are controlled from the main switchboard There are also on the stage 150 bunch lights, 20 arc lights, 120 four hundred watt stereopticon lights, 1500 lights in the fire fly effect, also stars in the ceiling The cast uses electric candles The stained glass windows are all lighted up from the rear by powerful 1000-watt hanging bunch lights visible from the promenade

FOUR electric motors that raise 12 tons of scenery more than 60 feet to effect a lightning change of scene Wings 60 feet high against 16 in the ordinary production Three thousand individual costumes, of 470 patterns Thousands of lights of various sorts Five and a half tons of paint and three tons of lamp-black used on the various properties and fixtures Stained glass windows that took 22 days in their production by three eight-hour shifts of twelve artists each Properties totalling 1018 in number and running from a bishop's crozier to a half-ton bell Ten stage managers to see that the scenes synchronize Incidental music by 73 musicians and 120 singers all located in parts of the house ordinarily given over to the audience These are some of the high spots of the remarkable theatrical production illustrated and described herewith —THE EDITOR



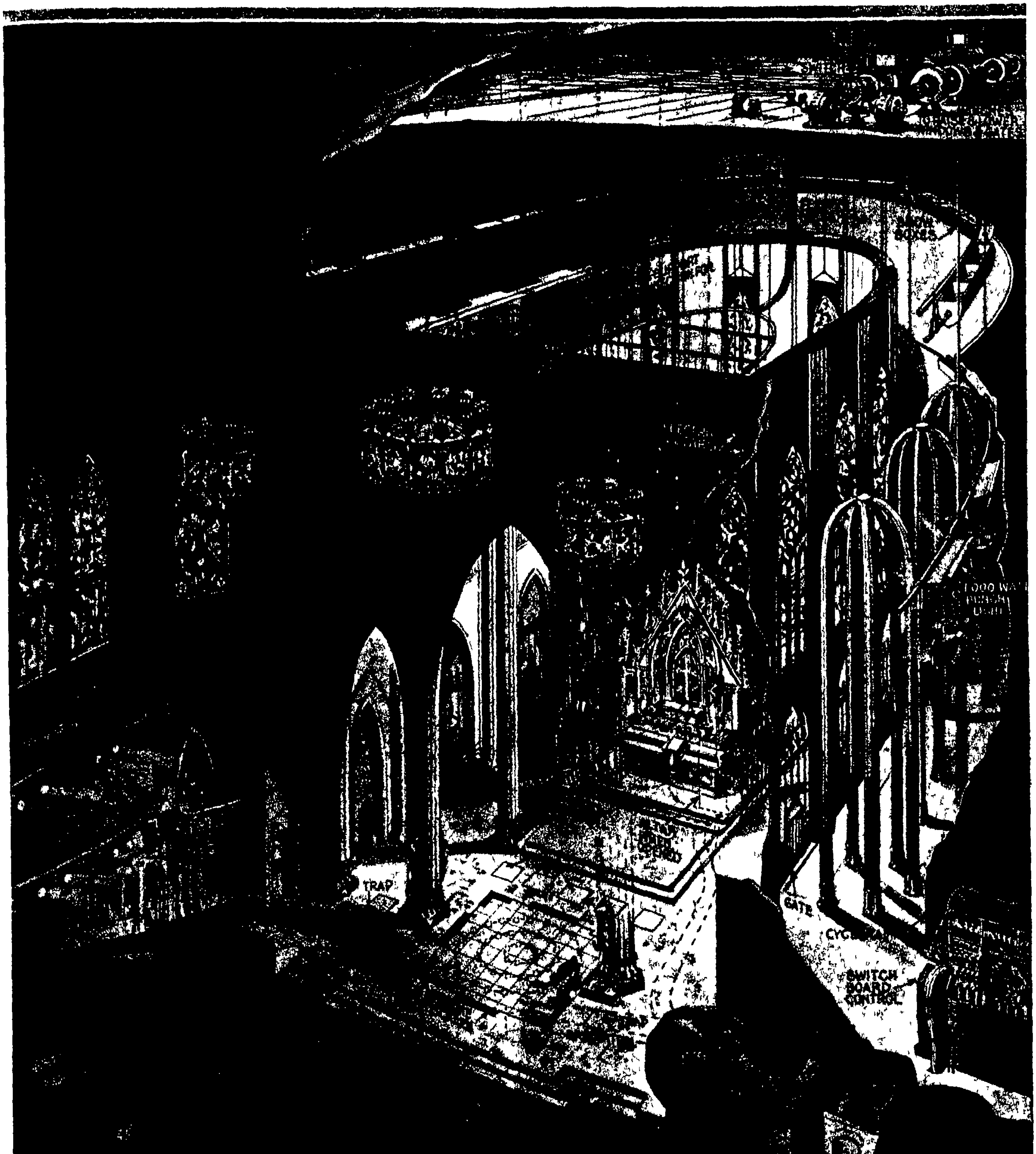
Through the kindness of Mr Eugene Braun we have been enabled to see everything electrical in his charge under the very best conditions for an electrician in a great production must be a kind of daily inventor True the effect may not always work but it may be a stepping stone to something the next day, which will Practical men of the stage have the courage of their convictions Two tons of stage snow were provided made of fireproof paper and were shaken down from the rim of the horseshoe at the sides of the false ceiling of the cathedral It was found that this snow fouled the lamps and it was abandoned

One of the most striking effects is produced by flooring with glass a portion of the front of the stage beyond the line of the absent proscenium arch, and placing underneath in the first cellar spotlights controlled by a regulator Much of the allegorical action occurs here, the "shadow of death' appearing at the end of each scene when one or more of the actors lie on the vivid flooring The ultra violet ray is used at the end of every scene the apparatus being attached to four of the spotlamps in the top gallery The unearthly and ghastly color is produced by projecting these rays on a white cap used by one of the actors

The smoke for the screening of the "quick change" is generated in the lower cellar and is kept in a large galvanized iron tank in the intermediate cellar, to be driven by fans through sheet metal pipes to the outlets at different parts of the stage We are indebted to Mr Oliver M. Sayler, author of "Max Reinhardt and His Theater" for many courtesies in connection with the present article

Patent Office Procedure

OF considerable value to all those interested in the prosecution of patent cases, whether attorneys, inventors or examiners is a pamphlet published by the Patent Office Society under the title "Manual of Patent Office Procedure" It contains a very comprehensive summary of the sort of thing which its title covers, made by E S Glascock one of the Principal Examiners in the Patent Office together with such of the Commissioner s Orders as are still alive and pertinent to present practice Since some of these orders date back as far as 1875 and only a small proportion of them are still effective, it is obvious that on this count alone the book contains much information difficult to locate elsewhere The same is true of the actual procedure



The entire stage back of the first columns is arranged so that all the scenery is raised at one time while obscured by a smoke screen. The space is so large that our artist has had to take certain liberties with the gridiron to get in all of the mechanism

HOW THE CENTURY THEATRE WAS CONVERTED INTO A CATHEDRAL FOR THE PRODUCTION OF "THE MIRACLE"

Our Point of View

The Public Conscience

ELSEWHERE in the present issue will be found a discussion of the technical aspects of the Naval oil reserves, which will throw some light upon the question as to whether it was better to leave the oil in the ground as crude petroleum or pump it out and place it in tanks ready for emergency use.

The heading "our point of view" at the top of this page leads us to go a little further and give expression to a feeling which for us at least stands out preeminently above the many emotions of shame and humiliation which have been aroused by the Naval Reserve scandal. We have in mind the healthy reaction of the public conscience as shown in the universal demand that any man who shall be proved to have betrayed the public trust, no matter how exalted his social or political standing, be brought to justice, and punished with the utmost vigor of the law.

The heart of the American people is sound, and we believe that the men they elect to represent them at Washington appreciate the sacred nature of their trust. Such faults as they may have are those of the head, not of the heart. In their probity and good faith they are representative surely of the public conscience. Should the time ever come, however, when the American people lose faith in the unassailable rectitude of their President and his Cabinet, their Senators and their Representatives, we may look to see a Mussolini come striding across the land, or a Cromwell pointing to some insignia in the halls of Congress and shouting "Take away that bauble!"

How far we are removed from any such debacle has been shown in the ruthless determination of President Coolidge and the Senate to cut out this moral cancer and run the knife along its roots until not a vestige remains. There is no room for politics around the operating table, and the present investigation must be carried through in the non-partisan spirit which characterized the public utterance of the President.

Propaganda

THERE is no word in the English Language whose meaning has been so sadly distorted as the word "propaganda." The change took place mainly during the late war, when the term took on a decidedly sinister complexion.

If you turn to the Standard Dictionary you will find that the word was applied to a congregation or society of cardinals for the care and oversight of foreign missions which was instituted at Rome in the year 1622. It was applied also to the College of the Propaganda at Rome that was founded by Pope Urban VIII for the education of the missionary priests. Hence in later years the word came to be applied to any institution or scheme for propagating a doctrine or system.

Judged by this definition, we can see that in its true sense propaganda is a perfectly legitimate form of human activity. Any society, whether it be social, religious or political, which is possessed of certain beliefs, and sets out to make them known, either by the spoken or written word, is practicing propaganda.

Truth is mighty and must prevail, and if any body of men believe that they have discovered a valuable truth, it is not merely their privilege but their duty to disseminate that truth. If they realize, as they quickly must, that this spreading of the truth can be done upon a large scale and effectively only by organized effort, they will make use of the press and the platform as the best means to give it wide circulation. Propaganda becomes vicious and reprehensive only when its authors consciously and deliberately disseminate what they know to be lies, or when they aim at effects which they know to be prejudicial to the common good.

Propaganda in its proper meaning is a perfectly wholesome word of honest parentage and with an honorable history. The fact that it should today be carrying a sinister meaning merely shows how much of the child remains in the average adult. A group of citizens writes and talks in favor of a certain course of action in some debatable question, believing that it is promoting the best interests of the community. Propaganda? Not a bit of it. Just a plain forceful statement of truth. But let another group of citizens express opposing views, and they are promptly labeled with the sinister name of propaganda.

A curious illustration of this illogical attitude and the misuse of a perfectly good word was seen in the Senate investigation of the Bok Peace Plan. Many of the active members of the Committee had been foremost among the opponents of the principles contained in the League of Nations. In the Senate and out of it, on the platform and in the press, they had shown an opposition to the League which became almost pathetic in its unreasoning fury. Was this propaganda? Perish the thought! But when a private citizen, wishful of getting a cross-section of public opinion on the question, offered a prize and published the winning essay, these gentlemen of the Senate felt that they had put the whole matter completely under the ban when they shouted propaganda! propaganda!

"What is sauce for the goose is sauce for the gander" says a wise old proverb. Let us make haste to put this fine old word back where it belongs, and restore its dignified significance for the use of our children and our children's children.

Save the Birds

EVERY year millions of migratory birds wing their way across the United States. During their long flights, they break their journey at suitable resting places, which in the case of waterfowl consist of certain marshes and the bordering shallows of our lakes and rivers which the birds have used year by year from time immemorial as places of rest and for feeding and mating. These marshes are as essential to the existence of our waterfowl as the very air they breathe.

Bird hunting is as ancient as the history of man himself. From the very first it has formed an important source of his food supply, and through untold centuries the supply was seemingly inexhaustible. But the earth's population multiplied, weapons of precision were placed within reach of the poorest huntsman, and it began to be evident that, unless the protecting arm of the law were thrown around it, the bird life of the world in thickly populated countries would become practically extinct.

As matters stand today, the birds are protected by some effective laws. The sale of wild fowl is prohibited and it is unlawful to shoot such game during the mating season. Also the law imposes a "bag limit"—this last an excellent provision so long as it is not made too stringent. Unfortunately in some States the limit imposed is practically prohibitive of hunting of any kind.

But the marshlands which are so essential in the migrating season are also threatened with extinction. This is due to the present craze for the reclamation of flooded lands by drainage, as the result of which millions of acres of some of the most famous nesting places of the birds have been changed into barren wastes, in which nothing useful to man is growing or even can be made to grow.

The Scientific American has ever been an earnest advocate of reclamation, but we believe that this, like any other good policy, can be carried too far. Some marshlands, doubtless, can be drained to advantage, but before dams are built and ditches dug, it should be proved by expert survey and investigation, that the land so recovered will raise crops, grow fruit trees, and house a farming community. Hitherto too often no such care has been taken, with the result that some magnificent resorts of the migratory birds have been turned into dreary deserts.

This policy hits directly at the hunter of moderate means, to say nothing of "the one-gallus man," and unless the Federal Government steps in, millions of hunstmen who, during the open season, supply their tables largely by the shotgun, will have to hang it up as a memento of a day that has passed.

There is now before Congress a "Game Refuge Bill," by which, through an annual license fee of only one dollar, it will be possible to finance the purchase and maintenance of sufficient natural feeding and resting grounds to preserve our migratory birds for all time to come. The bill has the backing of the American Game Protective Association, the Audubon Society, and practically all conservationist societies. We commend this measure to the support of both the bird lovers and the bird hunters of the country, who should be equally interested in its passage.

Is Oil a Mineral?

A CORRESPONDENT recently called our attention to an advertisement of an article in one of our prominent journals, in which oil was spoken of as a mineral, and asked us whether this was correct. As a matter of fact, no authority is prepared to state definitely whether oil should be spoken of as of organic or mineral origin. We asked the question the other day of the Geological Survey, and were told that nobody authoritatively knows, but they are inclined to believe that it may be derived from a vegetable or animal source, or from both. It is possible that in remote geological times during some convulsion, animal life, whether of the land or sea, together with much vegetable growth, died and was submerged with the sandy formation in which the oil is now found, and that the heavy petroleum oil which exists among the sandstone, limestone and oil-bearing strata represents what is left of these organic materials. This, however, is no more than a surmise.

But if there be some truth in this theory, how does it come about that oil is classed by the geologists as among the minerals? The answer is that it is found in mineral formation, and the process by which it is mined and recovered from the earth places it among the mining activities. Hence, it has come to be classed as a mineral. Some day investigation may establish its true origin, and it is possible but not probable that it will prove to be mineral in its origin. Until that time, it will be correct to speak of it as a mineral.

The Coast and Geodetic Survey

THE proposal to transfer the work of the Hydrographic Office to the Coast and Geodetic Survey forms part of the plans of the Government to secure economy by consolidating the bureaus, departments, etc., and so preventing wasteful duplication of work. With this effort we are in thorough accord—it is imperatively necessary. But in the transfer of activities, great care should be taken to insure, not only that the work will be done as well, or even better than before, but that the economy aimed at will be secured.

Judging the problem from these two standpoints, so far as it affects the Hydrographic Office and the Coast and Geodetic Survey, we are still of the opinion that greater economy can be secured by abolishing the Coast and Geodetic Survey and transferring its Geodetic activities to the Geological Survey and its Coast Survey work to the Navy. This proposal must not be taken as any reflection upon the character of the work that is being done by this office, whose excellence is everywhere recognized. But if economy is being sought, it seems to us that the division of its work between two existing government institutions that are fully qualified to carry it on is the logical solution.

So far as the Navy is concerned, the multiplication of bureaus and offices has been due, in part, to the persistent efforts in the past to take away from the Navy various of its activities. The Navy once was responsible for our lighthouses and the buoying of harbors. That was taken away and a separate bureau was created to do this work, and this in turn meant more personnel and increased cost. We suggest that if economy through consolidation is being sought, it would be well to abolish the Lighthouse Bureau also, and transfer its duties to the Navy, the excellence of whose lighthouse administration has never been questioned.

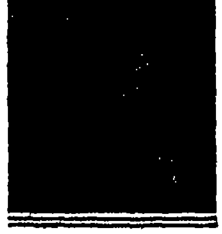
Here and There

EVERY year, the Franklin Institute, of Philadelphia awards a gold medal for the best contribution to science for the preceding twelve months. It has been rather the custom, of late years, for this to fall in the field of atomic physics or that of electricity. The 1924 award, covering the achievements of 1923, departs from this precedent, and goes to a worker in surgery. The development of specific apparatus for surgical purposes—the application of invention to surgery, in fact—has taken long strides of late years, and nowhere is the spirit of this advance better exemplified than in the design by William Gaertner of Chicago, of an injector for use in dosing with serums and in blood transfusion. It is this device which has been recognized as the year's outstanding contribution to science, and rewarded as such by the Franklin Institute Gold Medal. Mr Gaertner in the accompanying photograph shows deep interest in something—we suspect that it is his ingenious serum injecting apparatus rather than the medal which it has brought him.


William Gaertner

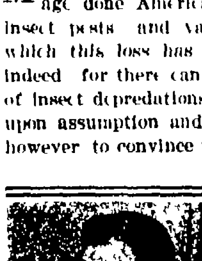
ONE of the most extraordinary surgical cases arising out of the war was recently reported from Australia. The patient was badly gassed and while under treatment manifested indications that the poison effects of the gas were centering on his skin. In short time the entire epidermis peeled off his body leaving him a mass of raw flesh. All efforts to graft skin or promote a new growth have failed. Contact of any sort is of course extremely painful. The patient has spent the last four years in a water bath at carefully regulated temperature. Ingenious arrangements are provided so that he may sleep without danger of drowning—a fate narrowly escaped several times during the early history of the case. No hope for cure or even for alleviation is held out, but we gather that, aside from the obvious discomforts of his situation the patient is in good health and fair spirits! The definite statement is made that the desire for relief through death no longer exists.

JUST by way of adding a little personal touch to the story that appears on pages 222 and 223 of this issue, we give here the photograph of Major F L Martin, squadron commander in charge of the four planes that will attempt the round the-world flight. There seems to be some doubt whether the route outlined by Lieut McDarment will be the one actually flown over certain minor deviations being still under discussion. In particular, the fact that the four planes are now at Santa Monica, only fifteen miles from Los Angeles has led to the substitution of the California city for Seattle as the official starting point so runs the latest report. The plans as we go to press, too late to make any change in Lieut McDarment's text, are for Major Martin and his staff to assemble at Santa Monica on March 1st, and to start the flight as soon as practicable thereafter. Seattle remains on the route, but will not be the first scheduled stop.


Major F L. Martin

ONE of the questions which most inquiring minds have at one time or another considered is that of the most-used words. A systematic investigation of this has been completed by Prof Carl C. Bringham, of the Princeton Department of Psychology. The leading places on his list of verbal best sellers are particles of one sort or another, as might be expected, but their order will in some respects be surprising. The preposition "in" holds the ranking place followed in order by and, that a the, to, with be, of, as all at not for on. It will be noted that "all" is the first entry of real adjectivial or nominal significance. Of true nouns the most frequently used was found to be "time" and after it come day, man place, year and work. The census of the words was a composite compilation from 625 000 words of juvenile literature, 3 000 000 from the Bible and English classics, 90,000 from the daily newspapers, 50 000 from books on cooking sewing, farming and the trades in general and 500 000 from correspondence. It would seem that the representative character of this array might be questioned—certainly few if any of us are concerned with the classics thirty times as much as with the daily paper. But whether a change of base in this respect would materially change the count might also be questioned. In any event we have this count as the most authoritative answer of the moment to the question "What words do we use most?"

MANY estimates have been made of the annual damage done American crops through the ravages of insect pests and various indeed are the figures in which this loss has been expressed. It must be so indeed for there can be no census either of insects or of insect depredations any estimate must rest largely upon assumption and guess. We do not need figures, however to convince us that the crops eaten and otherwise destroyed by insect life mount up to an alarming total every year. The boll weevil is perhaps the chief single item of concern but his ravages are confined to the single crop. Where a voracious customer like the grasshopper occurs in large numbers on the other hand the agriculturist has no escape save by fighting the pest, for if not met and destroyed, it will wipe out all his crops. Our photograph shows Prof M A Cobb of the Bureau of Plant Industry of the Department of Agriculture, who figures in the news of the month by virtue of the great work which he has done toward freeing our farmers from this source of anxiety.

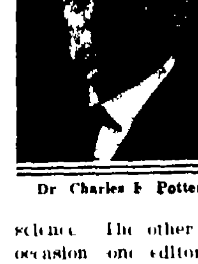

Prof M. A. Cobb

ANATOMISTS who have explained the functions of the thyroid pituitary and other ductless glands have been puzzled to account for the thymus a small gland just above the heart. The Carnegie Station for Evolution at Cold Spring Harbor, N Y, have found the answer. The thymus is one of those things that we have outgrown but that have not yet disappeared from our anatomical structure. It is a relic of the days when the human ancestor was in the stage of evolution involving the laying of hard shelled eggs. Experiments on pigeons showed that thymus deficiency led to the laying of fewer eggs, with absurdly thin shells, and with embryos that seldom survived the hatching process. The feeding of thymus extract to birds thus afflicted restored the egg laying function to normal, both quantitatively and qualitatively.

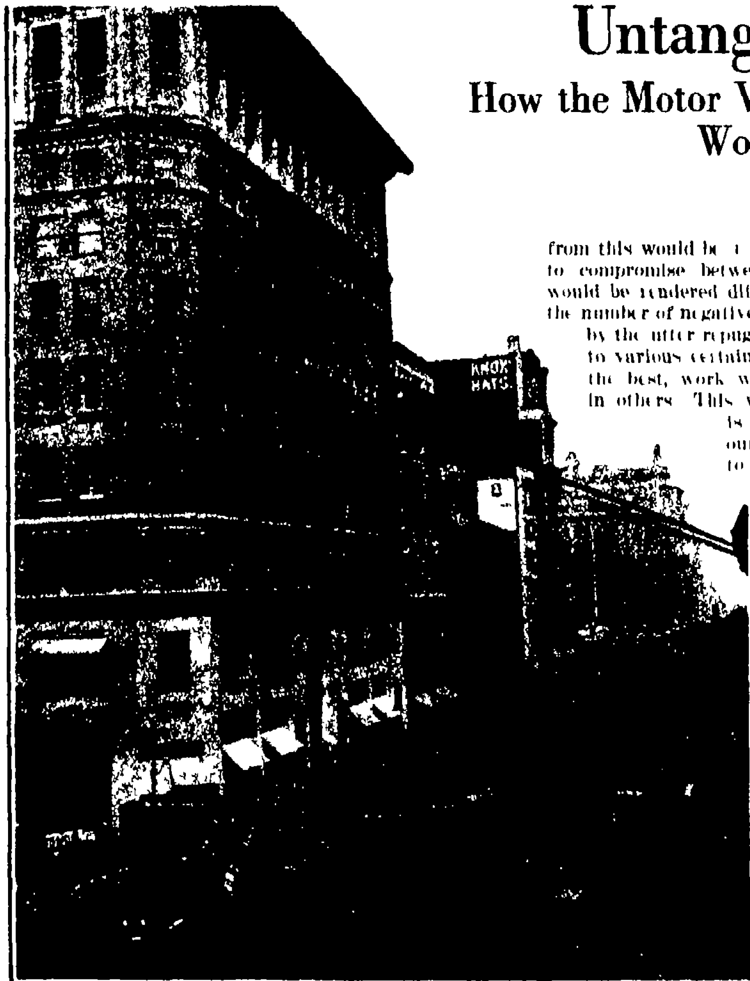
AMONG the interesting scientific oddities of the past weeks has been the first execution under Nevada's statute, enacted if memory serves several years ago, and specifying lethal gas as the instrument of capital punishment in the State. A Chinese murderer was the victim. He was shut in a gas tight chamber and hydrocyanic acid sprayed into his atmosphere. Observations were made through a glass window, and it was agreed that the subject died instantly and painlessly. Movements of the head which continued for some six minutes, were ascribed to reflexes similar to those of familiar frog's leg. It had been intended as a measure of scientific interest, to make an effort at resuscitation but the time which elapsed before the observers could safely enter the death chamber was so long that this would obviously have been futile so it was not done. In addition to its scientific aspects the case had an interesting legal side the sentence was appealed to the United States Supreme Court on the ground that such a method of execution was a "cruel and inhuman" punishment and therefore unconstitutional. The court refused to credit the claim that one form of painless death was more cruel than another, and dismissed the appeal.


Dr John Roach Straton

MR BRYAN is threatened with eclipse as the central figure of the evolution controversy. Two New York clergymen whose portraits appear herewith have recently been discussing this and other subjects in a series of joint debates, making a big hit with their auditors with the press and with the public at large. Dr John Roach Straton is a Baptist of ultra-conservative hue, and Dr Charles Francis Potter is a Unitarian and altogether a Modernist. Naturally they find plenty to disagree about and when they meet the doctrinal wool flies freely. In a recent series of five debates, three dealt with topics of strictly theological interest but one was explicitly on evolution and a second was primarily concerned with the Biblical infallibility and hence involved evolution as the natural alternative to the first chapter of Genesis. The misunderstanding of the term which is so common was avoided by the adoption of the broadest definition that of Le Conte "evolution is a continuous progressive change according to certain laws and by means of resident forces" It is significant that in both debates the negative won. That is to say, when the question was (in effect) that the organic world had come into its present condition by the operation of evolution Dr Potter could not prove that it had, and Dr Straton's case prevailed but when the question put the burden of proof upon Dr Straton requiring him to support definitely the infallibility of the Bible he likewise found himself unable to shoulder the burden successfully. This probably represents rather well the present status of the issue between the literal interpretation of the Bible and the liberal reading demanded by modern science with its ideas of evolution and its demand for millions or billions of past years for evolution to have worked in.


Dr Charles F Potter

RADIO broadcasting continues to make progress month by month. Not only in the matter of program features but in quality of reproduction the radio broadcasters have been steadily improving in their services to the great radio audience. It seems only yesterday that one of our editors went to the original WJZ station in Newark and delivered a quarter-hour talk on science. The other editors secured radio sets for the occasion one editor borrowing an airplane receiving set salvaged from some Army junk heap. It was a rare treat to hear our confrere talk over the radio. In the short space of two years this broadcasting business has become commonplace. Only a few weeks ago we heard the same editor speak from station WOR in Newark. So natural was the reproduction on our loud speaker that we could even hear when our somewhat nervous confrere gulped down a glass of water!



Untangling Our Automobile Laws

How the Motor Vehicle Commissioners of Ten Eastern States Are Working Together Toward Uniformity

By the SCIENTIFIC AMERICAN *Staff*

ALWAYS the danger is present, when some proposal for legislative relief from an uncomfortable situation is being freely talked about that the talk will exhaust the matter and there will be no action The automobiling public however, at least in the states named in this article, has every guarantee that the discussion of uniform motor-vehicle laws will not end in talk The organization which we describe has made in two years a very large contribution toward uniformity If the idea can but be introduced in all our states, and if we will but be satisfied with a gradual working toward the goal it is the best means for remedying the intolerable conditions outlined in the preceding articles of this series in the SCIENTIFIC AMERICAN *for January and February In future issues we shall analyze the problem further, and show other means of promoting uniformity and of dissolving the present tangle into which traffic has got itself in our most highly motorized states For the background of facts about which the present article is built we wish to acknowledge our heavy indebtedness to the kind cooperation of Hon Robbins B Stoeckel Motor Vehicle Commissioner of Connecticut* —THE EDITOR

HAVING agreed upon the abstract proposition that our motor vehicle and traffic laws ought to be approximately the same throughout the United States and upon the concrete one that at this time they fall far short of such uniformity the next point to be discussed is obvious What are we going to do about it? Through what agency and under what jurisdiction are we to seek uniformity?

Several readers have taken up the argument here to urge a Federal automobile and traffic law To be sure one's first impression would be that the way to have uniform law is to have one law and that the way to have one law is to have Federal law But more deliberate consideration casts doubt upon the wisdom of putting this problem in the hands of Congress

The members of a state legislature are of two opposed political parties and in addition they often divide sharply on the basis of city vs country But aside from these two points they represent a fairly homogeneous and compact whole, with identical interests throughout the State In almost every instance, a State is either a manufacturing or an agricultural or a mining one its major road problem revolves distinctly about maintenance or distinctly about original construction it produces gasoline or it doesn't the manufacture of automobiles is or is not one of its major industries its large cities are terminal points so that (like Massachusetts New York and Pennsylvania) it profits from through truck traffic or else (as with New Jersey and Connecticut) its position with respect to such traffic is substantially that occupied by Belgium in the war On every major question of policy toward cars trucks gasoline roads taxes and other automotive problems a clean cut decision can usually be reached as to where the best interests of the State lie and a bill can be prepared and passed dealing with any given point in such fashion as to conserve these interests Then when conformity with a nation wide legislative standard is desired well considered and definite action can be had on every count and failure to conform on some counts will have no influence whatever upon the possibility of conforming on others

In Congress the case would be quite different All the varied interests of the preceding paragraph and many others would be pitchforked into the one ring Congressional discussion of any proposed uniform automobile and traffic laws would degenerate into an orgy of bickering and log-rolling Any bill that might issue from this would be a horrible hodge-podge—an attempt to compromise between irreconcilables Its passage would be rendered difficult or impossible by reason of the number of negative votes that would be necessitated by the utter repugnance of various of its provisions to various certain States If enacted it would at the best, work well in some sections and poorly in others This would not be Congress fault—it is inherent in a country as big as ours Our whole effort ought to be to keep issues that involve variant local viewpoints out of Congress rather than throwing them into Congress as we so often do

Speaking specifically of the automobile situation we want substantial uniformity, but we must face the fact that complete uniformity on all features of the law among all 48 States is not possible We must permit each State to determine for itself whether it can or can not conform on each proposed count

Another major point would be that of taxation The Federal Government already infringes rather largely upon the sources of taxation that are available to the States Certainly the proposal to rob the States of the automobile license tax would be resisted to the last ditch And so much of the machinery of automobile law and automobile administration revolves about the taxing and licensing powers and procedure that a Federal law with State taxation would be impracticable

It might be urged that the Federal Government could administer the law and collect the taxes apportioning these among the States The weaknesses of such procedure are obvious but we may pass over them and inquire about the enforcement and administration of a Federal traffic and tax law Under the existing regime the State administration and the State courts and the State police provide an efficient machinery for taking care of the automobilist in his contacts with the law Were the Federal Government to take over this business, the States would perforce drop out The Federal Government would be left holding the bag and an enormous new clerical and judiciary machine would have to be built up more than absorbing all the money that could possibly be wrung from the automobilist Just one point to illustrate the impracticability of this proposal would the traffic officer become a Federal appointee outside the local police force or would he remain a municipal policeman, regulating his busy street corner under Federal laws and regulations, and appearing in Federal court against any offenders whom he might arrest or summons?

No control of the automobile is essentially a State matter Desirable as is uniformity, it is to be achieved, if at all, by action among the States Offhand that sounds hopeless It will doubtless surprise many readers to learn that steps toward voluntary cooperation between the States have already been taken, with results that justify an enthusiastic outlook upon the ultimate possibilities The agency through which this progress has been achieved is one that has itself grown out of the automobile

Historically the motor vehicle became a problem in State administration only with the introduction of licenses The attempt to keep up with the industry's growth has run substantially parallel in all States Imposition and collection of the tax was originally in the hands of the Secretary of State, and that of enforcing the traffic laws became in the natural course of events a police matter Ultimately the automobile license bureau grows into a separate administrative department of the State under an official holding some such title as Commissioner of Motor Vehicles Once this post has been created much of the machinery of administration of the ordinary traffic laws gravitates into the incumbent's lap, because of the close tie-up between licenses and convictions because of the necessity which ultimately appears of keeping the complete record of every car and every driver and because of the unforeseen complexities and ramifications of the whole business of regulating the motor vehicle which fairly demand a single specialized administration

The Motor Vehicle Commissioner is simply forced to be competent—if he isn't the office very soon gets the better of him and he makes way for a successor who is He holds one of the most responsible places in the State administration and his very tenure of office if it does not break him makes him an expert in his field He goes to the legislature asking for certain measures and telling why he wants them and the law makers give him what he wants on a liberal scale because of the obvious disinterestedness and the obvious authority behind his requests More than in any other department of the State administration the Motor Vehicle Commissioner becomes the organ and mouth piece of the entire State with reference to all things falling under his jurisdiction

Well wouldn't it be a good idea to get these Motor Vehicle Commissioners from the several States together once in awhile get them to discuss and agree upon matters of common interest, get them to take the results of such discussion and agreement before their home legislatures? We have every now and then a more or less informal conference of Governors to attain harmony on matters of common importance Wouldn't there be a very large prospect of unravelling a lot of the tangles now existing in our 48 traffic laws by means of such conferences of the Motor Vehicle Commissioners?

There would be, most emphatically And as a matter of fact there is.

By invitation of the Tax Commissioner of New York State (who discharges the functions of Motor Vehicle Commissioner, so far as they are discharged at all in the Empire State under existing law), representatives of the motor vehicle administrations of Massachusetts Rhode Island, Connecticut New York, New Jersey Pennsylvania and Maryland met on Sept 28, 1921, and drew up articles of association under which, on November 18th, the Conference of Motor Vehicle Administrators was definitely organized for business These articles set forth the membership of the Conference, they provide that each State shall be represented at each meeting by one or more members of its motor vehicle administration but that each State shall have a single vote They create a President and Secretary of the Conference, and an Executive Committee, they provide

(Continued on page 288)

Houses of Mud

Old-Age Pise Construction as an Answer to the High Cost of Building Materials and Labor

By Juanita W. Porter

SINCE Kansas City is to have the first house in America to be built of a material used in Europe for ages—pisé—the public is anxious to know something about this substance. Pisé: what is it? What is its origin, its appearance, its advantages as a building material—if it has any?

The structure to be made of the pisé is an English residence. A model farm may follow this experiment providing it comes up to the expectations of the builders. The house just being erected is one which promises much. It is Old English in type, is made of the pisé or rammed earth, with a stone foundation upon which are laid split railroad ties. Shingles of asphalt are to be used for roofing. A dividing wall in the grounds will be made of the same pise material coped with tiles.

Just what is pisé? It is merely the French for rammed earth and rammed earth is an exceedingly good material for building walls, walls for buildings as well as walls for defense. The odd thing is that its very obvious merits should so far have received such small attention. The construction of buildings by this method is exceedingly simple, the earth being converted into walls by means of molds made of shuttering, into which the earth is rammed by means of a pisoir or rammer. The rammer is of the greatest consequence as it is on the skillful handling of this tool that the firmness and durability and, in short the perfection of the work, depends. Although it may appear very easy to make—and an amateur *may* make it if he follows directions carefully—more difficulty will be found in the execution than at first seems possible.

A frame to hold the earth is made of shuttering. The planks are light wood one-inch thick each ten feet long and fastened together with four strong ledges on each side made two feet nine inches in height. This mold is divided into three divisions each of which requires one workman. Of these three, however, only one needs to be a skilled workman, thus eliminating much expense. Into this mold earth is poured to the depth of three or four inches. It is rammed or beaten with the rammer until it is firm and hard and the rammer does not leave a print. All water must be pressed out of the soil. This process is repeated until the mold is filled; then the boards are removed and another tier is made on top of the wall just completed. A nine-foot wall can be made in a day. In fact the building may be accomplished much more rapidly than by any other building process known, so it is claimed by the pisé proponents.

As regards the kinds of soil suitable for pisé building, all earths in general are fit for the use when they have not the lightness of poor lands nor the stiffness of clay. All earths fit for vegetation are suitable as well as brick earths. Strong earths with a mixture of gravel which for that reason cannot serve for making either bricks, tiles or pottery are also suitable. These gravelly earths are very useful and the best pisé is made from them.

It is obvious that a person experienced in handling pisé must superintend at least in part buildings made of this material. So fast is this method gaining ground in Great Britain that improved machinery is being introduced to do the ramming of the walls and this will expedite the work. Meanwhile the actual erection of pisé buildings presents so little difficulty that it can be done by anyone who has the strength to shovel earth and wield a rammer provided he will exercise the care to see that the molds or boxes into which the soil is shovelled are kept plumb and in straight lines. The pioneer settler even with no previous knowledge of pisé, may work on his building if he has a well thought-out plan.

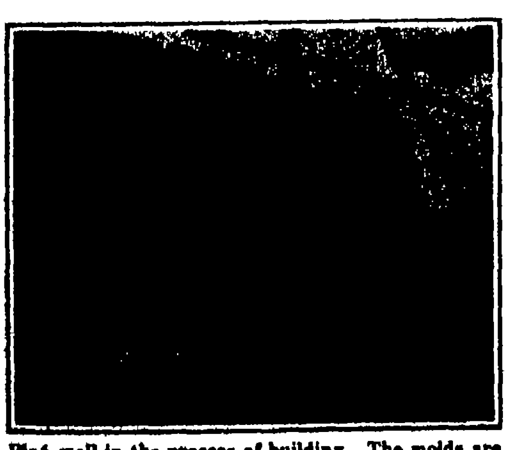
Pisé construction under way. Ramming the earth in the molds until the moisture is pressed out

Start of a pisé wall on a brick foundation. At the back will be noted the molds in place for a section of wall

Typical sectional mold employed in pisé construction abroad. The heavy cross-members make the molds extra firm

One difficulty in the use of pisé seemingly has been removed, namely the long supposed belief that the work could be done only in the warm season. In Canada where the climate is rigorous more than half the year structures erected in cold weather have been as free from cracks and as solid as those made in warm seasons. The consensus of opinion however is that it is better to build pisé houses when the weather is not too cold, thus eliminating an element of chance.

In order that a test might be made by modern builders of this old art a demonstration house consisting of six rooms and a barn attached was erected at Guildford, England several years ago. The walls though 18 inches thick cost less than $100 for the entire building as against the cost of brick walls which would be $1000. A house of this size can be built in a fortnight and it will last for generations. The test was so satisfactory that leading English architects have taken up the work of building pisé houses as one outlet and a very important one, through the almost blank wall of building pessimism existing in England today. Indeed it is largely through building with pisé that there seems any possibility of relieving the housing situation in those countries where the shortage in lumber, brick, cement and almost every material needed in a house with the added difficulty of the extortionate freight rates when those materials *may* be secured drove builders to seek some substitute. It seems highly probable that pisé offers the much sought way out of the dilemma.



Pisé wall in the process of building. The molds are shifted upwards as the construction progresses

Official Government reports show that in Britain raw timber is hardly obtainable and seasoned timber does *not exist*. The same is true of tiles, slates, corrugated iron and every other form of legitimate roofing substance. And if these products can be found in the raw all the brick yards in Great Britain cannot half way supply the demand since it will be five years before the output can equal what is needed *now* if those materials alone have to be depended upon.

Among the manifest advantages of pisé as a building material are: Its extreme cheapness. Untrained labor mostly can be employed. Besides this economic advantage there is the saving of transportation charges, now such a bugbear to builders, since soil always is near at hand.

Comfort of pisé houses. Many degrees cooler in summer than even houses of brick and warmer and easier to heat in winter than any other.

Practically indestructible. Records exist of houses built nineteen centuries ago and still in perfect preservation.

Small expense of upkeep. The doors and windows are the only parts requiring paint or replacement.

Practically fireproof. Since only the floors, windows and door casings are of lumber and often even the floors are concrete there is little to burn.

Another way in which pisé makes an appeal is its adaptability to many finishes. With either stucco or fresco—the latter a very inexpensive yet beautiful finish employed in France—a most beautiful exterior can be obtained. Such houses appear like far more costly residences. If a perfectly unadorned building is needed, such as a barn in a country place or houses to hold war supplies, pisé with no finish answers all needs of service and durability. The same building with a coat of rough gravel makes a more sightly building at a very little added cost.

A Static or Dynamic Atom?

IN *Nature* for April 28 Prof. W. R. Campbell says that some writers still contrast the static atom of Lewis and Langmuir with the dynamic atom of Bohr as if the two alternatives were mutually exclusive. It does not seem to be realized generally, Prof. Campbell says, that any inconsistency there may have been between them has vanished completely with the publication of Bohr's later views on atomic orbits, since speculations about chemical constitution based on the *static* atom can be translated directly into the language and conceptions of the *dynamic* atom.

The fundamental idea of Lewis is that non-polar combination consists in the sharing of electrons between atoms in such a way as to complete stable electronic configurations. If the sharing of an electron means the sharing of an orbit and if the stable electronic configurations are those in which the groups of highest quantum number are completed as they are in the rare gases, then the Lewis-Langmuir theory expressed in terms of Bohr's conceptions states that such compounds are formed when some of the electronic orbits instead of surrounding one nucleus only surround both and therefore help to complete the quantum groups of both. It is then merely a matter of linguistic alteration to interpret in terms of a dynamic atom conclusions which have been reached on the basis of the static atom.

The Story of Steel—IV

The Huge Blast Furnace, in Which a Fierce, White-Hot Fire Reduces Iron Ore to Pig Iron

THE enormous tonnage of ore brought down the lakes totalling in a single year 50,000,000 tons has to be disposed of quickly at the end of its journey That part of it which is to be turned into steel on the shores of Lake Michigan and Erie is loaded into huge stockpiles at the various steel works and that which is to be converted in the Pittsburgh district is transferred by unloaders from the ore ships directly to railroad cars

The vast steel plant at Gary on the southern shore of Lake Michigan contains the most up-to-date plant in the United States and handles the largest amount of tonnage Here the ore steamers enter an artificial canal, 22 feet deep and 250 feet wide which extends 4050 feet inland from the lake The ore is discharged from the ships by ten Hulett unloaders of the type described in our March issue which deposit it in a long trough parallel with the dock Working in conjunction with them are ten Hoover & Mason travelling conveyer bridges These huge structures are 500 feet in length and each one carries a 15 ton grab-bucket They dig the ore up from the trough and carry it back to a stockpile storage basin from which it is taken as needed to the blast furnaces 12 of which are arranged in a long line parallel with the stockpile The storage yard which is 4000 feet in length, has a capacity of 5,000,000 tons which is sufficient to keep the Gary plant going during the winter months when navigation is suspended and no ore can be brought down

Parallel with and back of the stockpile are twelve 550-ton blast furnaces each provided with four hot blast stoves these are approximately the same height as the blast furnaces and but little smaller in bulk Between the stockpile and the furnaces is a long line of elevated storage bins in two parallel rows one for coke and the other for ore and limestone The material from these bins is delivered into electrically operated lorries which carry the materials to the furnace skip of which there is a pair to each furnace The skips run up an inclined railway to the charging platform at the top of the blast furnace each trip of the skip being made in sixty seconds and its average load consisting of 7000 pounds of ore or 6000 pounds of limestone or 3000 pounds of coke On its arrival at the top of the furnace the skip automatically discharges its load into a hopper at the top of the furnace Within the furnace are two cones The contents of the skip falls upon the first cone which is then lowered allowing the materials to fall upon the second or lower cone The upper cone is then drawn up sealing the exit and the lower cone is lowered discharging the materials into the furnace This arrangement prevents any escape of the furnace gases

The furnace once started is kept going continuously night and day month by month and year by year until repairs become necessary There are furnaces which have a record of several years continuous operation The drawing on the opposite page and the text which accompanies it explain very clearly the operation of the furnaces and the process by which the iron is separated from the ore and collected at the bottom of the furnace The air for combustion is introduced at the bottom of the furnaces through a series of water cooled tuyeres which enter the furnace near the top of the hearth An enormous quantity of air is required for each furnace and this is supplied by huge blowing engines located at a distance from the furnaces The air enters at an average pressure of 18 pounds per square inch

The hot furnace gases are led by a large pipe from the top of the furnace into a dust catcher and after being cleaned in a washer they are led through the hot stoves, of which there are four to each furnace, as shown in our wash drawing and in the line drawing on this page The stoves are cylindrical plate-steel structures entirely filled with a honeycomb of firebrick As the gases enter the stoves (two stoves are heated at a time) a certain amount of air is fed in with them, and the burning gases as they pass through, raise the firebrick within to a high temperature When the proper heat is reached the gases are turned into the adjoining pair of stoves At the same time the cold air from the blowing engines is caused to enter at the bottom of the now heated stoves and, in passing up through the honeycomb it takes up the heat previously given up by the furnace gases, and enters the blast furnace at a high temperature thus restoring to the furnace a large measure of its heat

The operation of the blast furnace, as we have said is continuous and the temperature varies as shown in the accompanying page, from that of the molten iron (3500 degrees) in the hearth at the bottom to that of the cold charge as it is fed in at the top At regular intervals the slag and the hot metal are separately drawn off into large ladles the slag being hauled away to be crushed and utilized in the cement mills and the hot metal being hauled to the mixers and thence to the Bessemer converters or to the open hearth furnaces as will be described in subsequent chapters of the present series

Referring again to the drawing on the accompanying page it should be explained that the two right hand stoves are being heated by the burning gases which are led in and ignited at the bottom the valves from the cold air pipe just below being closed At the top of these two stoves the valves opening to the hot blast pipe are closed and the products of the burning gases are passed out through the tall smokestacks above the stoves At the same time the valves opening from the cold air duct at the bottom of the two left hand stoves are open the gas valves just above them are closed the valves controlling the smokestacks are closed, and the valves opening to the hot blast pipes are open

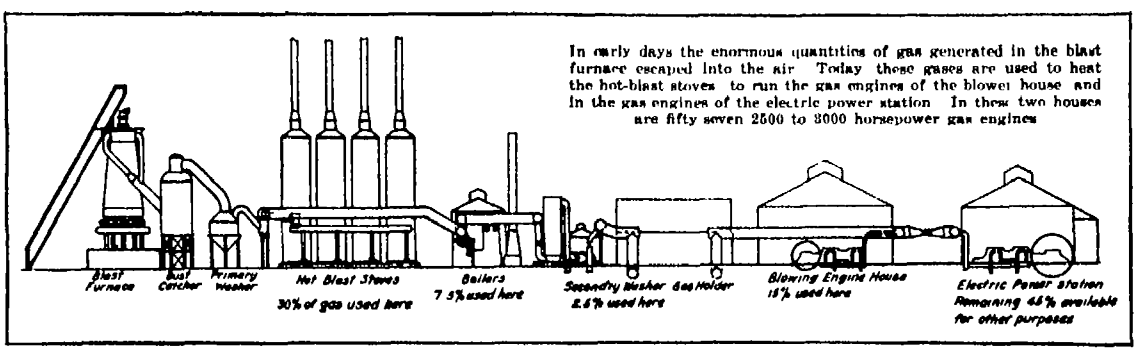


Diagram showing the distribution of the furnace gases at Gary

In laying out the Gary plant, it was possible to utilize all the past experience in the steel industry and effect large economies Chief among these is the utilization of the blast furnace gases for raising steam in batteries of boilers In operating gas engines for running the furnace blowers, and other gas engines for operating generators for the supply of power and light and for the vast Gary plant There will be some among our readers who like the writer, remember the time when no attempt was made to save the enormous and valuable volumes of gas which poured out of the top of the blast furnaces The first attempt to save part of these gases was to burn them underneath steam boilers and secure power for the operation of the blowers etc by steam engines The latest development is that carried out at Gary The diagram which we present gives the distribution now made of the furnace gases, of which the twelve furnaces at Gary produce *every hour* 40,300,000 cubic feet Of this total amount 30 per cent is used in heating the hot stoves The steam power plant uses 7.5 per cent The primary washers for the hot blast stoves and the secondary washers to clean the gas again before it goes to the gas holders uses 2.5 per cent of the gas Then the great blowing engines use 15 per cent, and the remaining 45 per cent is available for running the gas engines in the electric power station The gas as purified has an average heat value of 90 British thermal units per cubic foot and it is estimated that two and one-half times as much power can be derived from a given quantity of gas with gas engines as can be secured with boilers and steam engines The blast furnace gas serves to operate fifty seven 2500 to 3000 horsepower gas driven generators and blowing engines

Returning now to the process of reduction in the blast furnaces the limestone is used to 'draw' the silicon, sulfur, manganese, alumina and other ingredients, except phosphorus, out of the melting iron In this process there is formed a frothy substance (which includes ashes of the burning coke and various products of combustion which do not escape with the gas) which floats on the top of the molten iron This is the slag Practically all the phosphorus much of the sulfur, about three quarters of the manganese, and more or less silicon will remain in the molten iron It is the alumina, lime, and other ingredients of the ore that form the slag

Coke is used almost exclusively in the blast furnaces of the United States It is made by baking bituminous coal for 48 hours in closed ovens, two-thirds of a ton of coke being produced from a ton of coal The blast furnace coke must have special qualities. It must be strong enough to sustain without crushing the huge burden of 1500 tons of the load in the furnace It must be porous so that the hot blast may pass freely through it It must be very pure and burn with very little ash Coke consists of about 88 per cent carbon, and it is the burning coke together with the red hot blast as it comes from the stoves which completes the final process in the lower part of the furnace of melting the iron and the slag The pig iron as tapped from the furnace contains from three and one-half to four per cent of carbon which is subsequently reduced in the Bessemer converter

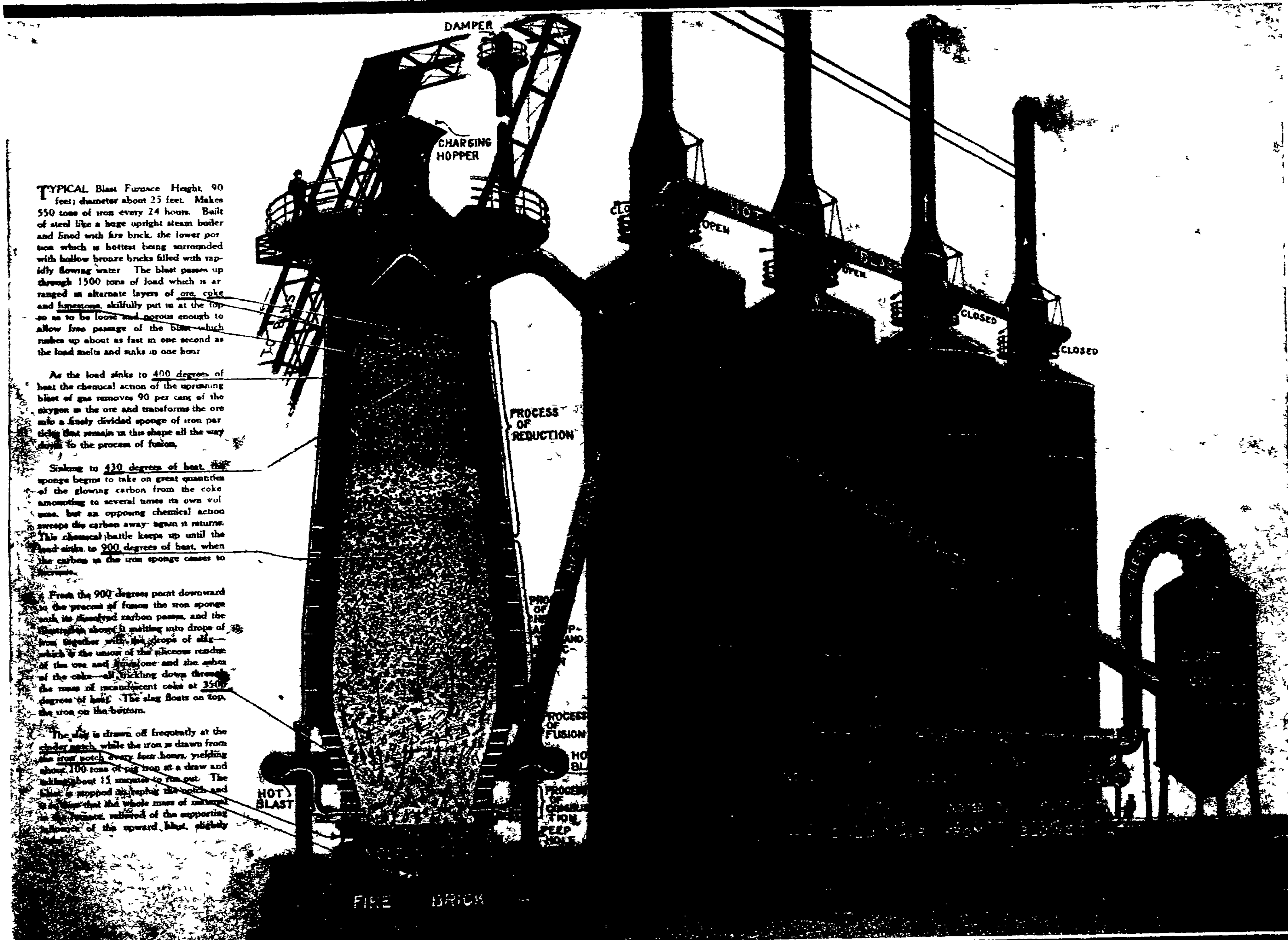
Water from Gasoline in Airships

THE cruising radius of airships such as the great navy dirigible 'Shenandoah' will be greatly increased in the flight of an invention now approaching completion as the result of months of study by the government aeronautical and scientific experts. The device makes it possible for the ship to burn up its store of gasoline without loss of weight and without increase of buoyancy This will result in the saving of many thousands of dollars worth of expensive helium gas that lifts the ship and which otherwise would have to be released and wasted to keep it from rising to dangerous heights

Gasoline is composed of carbon and hydrogen When burned the products are carbon dioxide, carbon monoxide and water vapor The first two gases escape The last is condensed Since gasoline requires more than three times its weight of oxygen for complete combustion and since about a third of that goes to form water, the weight of the condensed water is somewhat greater than that of the original gasoline This keeps the weight of the airship constant and makes unnecessary a loss of the lifting gas which heretofore has been a feature of long flights In an airship without the condensing device, the craft grows lighter as the voyage progresses owing to the consumption of the liquid fuel This results in the airship's rising higher and higher until in the interest of safety some of the buoyant gas has to be liberated This reduces the reserve buoyancy if unfavorable conditions are met, and so curtails the length of flights

Airships of the future equipped with the compensating water condensation device will be able to carry up fuel in quantity only limited by the buoyancy of the craft and the requirements of space, and will be able to burn it without releasing a compensating quantity of the precious helium gas

Water condensation apparatus will be installed on the "Shenandoah," formerly the "ZR-1," before long flights through the polar regions or elsewhere are attempted, according to present plans of the government experts. If the airship of commercial type the "ZR-3," which is now being built for the United States by the German government, is successfully delivered to this country, it also will be equipped with the new invention



TYPICAL MODERN BLAST FURNACE GROUP, SHOWING THE BLAST FURNACE, IN SECTION, WITH ITS SET OF FOUR HOT-BLAST STOVES

Our Psychic Investigation

A Summary of Results to Date, and a Plea for Better Mediumistic Cooperation

By J Malcolm Bird

Secretary to the SCIENTIFIC AMERICAN Psychic Investigation Committee

OUR February issue carried a summary of the conclusions reached to that date in our investigation of the electronic reactions of Abrams This was wholly in order All electronic practitioners are doing the same thing in substantially the same way The question of personal fraud enters so slightly that conclusions drawn from experiments with one disciple of Abrams may fairly be charged or credited against another But in the psychic field, each medium is an independent problem While a single successful demonstration would be sufficient to show that the objective phenomena of psychism occur, one would need a large number of experiments with a large number of fraudulent operators covering a wide range of phenomena and including no doubtful cases whatever before one would be justified in drawing a negative conclusion

Nevertheless, it is possible to review in some sense what our psychic investigators have accomplished in fifteen months, and to make from their experiences a few remarks of general applicability But first we must dispose of a few loose ends from our latest cases

Our brief against Mrs Y the flower writing lady, as given in our December issue was convincing enough to most readers, but of course there were those prepared to amend or reject it One of these was Sir Arthur Conan Doyle The obvious impossibility of setting down on the printed page every last detail left Sir Arthur without certain facts which turned out to be of essential bearing upon the questions which arose in his mind Hence he found our report in some respects incomplete in others a bit self contradictory and he felt that our procedure and perhaps also our conclusions had in some points violated common sense

One always expects Sir Arthur to make his opinions openly known and this he did with lengthy critiques in the *New York Times* and in *Light* the London spiritualistic weekly as well as by direct correspondence Replying to the printed comments in print and to the direct letter in kind we were able to supplement Sir Arthur's knowledge of the case and he himself unearthed data of bearing Finally the medium was so ill advised as to write to him making statements which must necessarily be false if we ourselves are in good faith As a result of all this Sir Arthur now states in the columns of *Light* that his doubts are resolved and that we are entirely justified in our conclusions and to us he writes in part

I am forced to the conclusion that your judgment has been correct I am bound to act as counsel for the defence as far as I honestly can but I am equally bound to admit it when I find that the case is indefensible I am now grateful to your Committee for having exposed a wrong one I hope a right one may come your way

Sir Arthur has been accused of blind credulity His own characterization of his attitude as that of volunteer counsel for the defence will be sufficient refutation of this and complete justification for his slowness to accept the hypothesis of fraud in any given case and his eagerness to see that every possible ground of doubt be thoroughly threshed over His statement in this case ought to dispose of all excuse for failure properly to appraise our evidence against Mrs Y

We spread these facts upon the record with no desire to harass Mrs Y but simply because she drives us to it On the appearance of Sir Arthur's long critique of our findings and using this as her sole text the lady "challenged" us to grant a review of her case before a Committee which should be chosen in half by herself and should sit in her home city She has used this challenge as a means of getting her name and ours in the papers and she promises in the event that we decline or ignore it to go still further in this direction We regard Sir Arthur's acceptance of our original verdict as a complete answer to this "challenge" and take this means of making plain the facts in the case If Mrs Y wants redress, we fear that she will have to make good on her threat of six months ago to sue us for libel

So much for Mrs Y Just a word of humorous back fire from Mrs. Tomson, the medium who "ran out" on us at the last moment According to advertisements in the Chicago papers, she is doing business at the old stand—'phone for an appointment At the end of her three-inch insertion is found a word of warning to the faithful "Pay no attention to false stories of jealous people or publications Mrs. Tomson's seances in New York were great triumphs. Proofs on file in our free reading room"

So that's what's the matter with us—we're jealous! Perhaps, some day we shall seek a cure in Mrs. Tomson's free reading room

Coming down to the Pecoraro case, we must present an alibi for Dr Vecchio We stated that if Nino won our money, Dr Vecchio expected to be the beneficiary This was based upon Dr Vecchio's remarks to a *New York Times* reporter made in our office and in the presence of members of our staff Dr Vecchio reminds us that this interview was given in Nino's presence, and was punctuated by conversation in Italian between himself and the medium He grants that he turned to the reporter and said "I have won the money, and I want it" but he states that he was translating what Nino had just said to him Dr Vecchio feels that the statement as published reflects seriously upon him and though we are inclined to think that at its worst it would merely indicate that Nino is a sort of peon of the doctor's we are very glad to present this modification

At other points in our story, we criticized Dr Vecchio's conduct where we felt that such criticism was in order Dr Vecchio insists that he is a scientist and an investigator, interested only in the truth One present at the seances and not having heard this would certainly take him for a very active protagonist of the medium But we are prepared to believe, and in fact we have at all times believed that this inconsistency between speech and action is unintentional on the doctor's part. He feels that our unfavorable comments upon his behavior might be taken by our readers as an attack upon his good faith so we hasten to repudiate any such intent We had no idea whatever of charging him with anything more serious than extremely poor judgment.

On the Pecoraro case we have had more comment from our readers than on any other and this comment is almost evenly balanced Half of those who write blame us for not tying Nino up tighter and the other half blame us equally for having tied him so tightly Presumably this would indicate that the way we did it was approximately right, but even so, a few words of explanation here are in order

Those who write letters to us on this subject are blessed with a fund of positive information which the researcher may well envy The one group state categorically that the materializing medium must have a decent degree of freedom within his bonds, or the materializing forces are absolutely inhibited. The other are equally positive that the medium may be rendered completely immobile without the slightest prejudice to any materialising powers which he may possess With our best respects to the proponents of both these theories, we are unable to find the slightest justification for any categorical opinion on the point, which we believe could be settled only by catching a genuine materializing medium (we assume for the purposes of argument that there is such a person) and trying it out.

We were quite aware of the objections, from the one side and from the other to the procedure which we adopted in our four sittings with Pecoraro Had we had complete freedom of action, we should have adopted many of the devices which are suggested by our correspondents and many which they do not appear to have thought of We should have tried the effect of substituting fine sewing thread for the ropes and wires. We should have tried the effect of [illegible] the medium in his place with sticking plaster, etc We should have tried the effect of a wire and of a textile screen between him and the apparatus. We should have tried the effect of handcuffing him to his chair We should have tried the effect of putting him inside a muslin bag and smearing the apparatus with black cold-cream (made so by addition of lamp-black—rendering it a fearful and wonderful mess), the expectation would then be that if the phenomena are genuine the smears would be mainly on the medium inside the bag whereas if they were done by normal use of his hands through the fabric of the bag, these smears would be entirely on the outside of the bag And we should have tried a lot of other things which we do not consider it expedient to put down in black and white at this stage of the game.

One never has absolute freedom of action in dealing with a medium, however. One always comes to the place where one must choose between the abandonment of the conditions which one would desire, and abandonment of the entire investigation With Nino we came to this point early and often, whenever any proposal was advanced to vary the conditions from those to which the medium is accustomed in his routine sittings with his friends. If we had felt it impossible to proceed without the desired conditions, we should not, of course have waived them But the sacrifice of these conditions involved merely our own inconvenience and a certain amount of precision of procedure, all necessary information to determine the character of the manifestations could be obtained in the way we obtained it

Further sittings, however, regarding which we expressed a provisional willingness, are something else. There will obviously be no profit at all in sitting some more with the same old silly arrangement of Nino's arms and hands. Dr Vecchio fails to see this, fails to understand the necessities of scientific investigation, fails to realize that in the end the investigators must have their way or abandon the matter He talks and writes only of the conditions under which he will "allow" us further sittings. So we have very definitely told him that there won't be further sittings with Nino, that this chapter is closed.

If one examines our experiences of the past fifteen months in search of a generalisation, one must be struck by the lack of quality in the mediums who have come forward "Mr X" was unknown outside the section of Pennsylvania in which he was operating. "Mrs Y" is fairly well known in spiritist circles in the Middle West, if only because of her conviction and expulsion as a fraud some years ago, but her name meant nothing to the general public Neither did Nino Pecoraro's; and from the spiritualist viewpoint his work is very crude. Mrs. Tomson has some place in the public mind, but not one of which she is likely to boast.

Compare these names with those of William Hope and Evan Powell, of Frau Silbert and the Schneider brothers, of Erto and Franek Kluski, of Ada Besinnet and Mrs Wriedt and the Jonsons. Plainly the "mediums" who have come before us are far from the

(Continued on page 291)

IT HAS been a matter of severe disappointment to us that, to date, our psychic investigation has attracted only mediums who have turned out to be of small genuineness or none at all. In order that there may be no material obstacle in the way of participation by any medium of high caliber, we now make this offer. To any such medium we will secure passage to New York, maintenance here for the necessary period, and passage home; and in the event that the medium accepting this offer fails to win our $2500 award, the money thus disbursed need not be repaid. The offer applies to the mediums Hope, Powell, Kluski, Erto, Willy and Rudi Schneider, "Stella C.," Frau Silbert, Mrs. Deane, Miss Besinnet, Mrs. Wriedt, and Jonson; as well as to any unnamed medium who proves worthy of consideration.

A Telescope of Record Dimensions

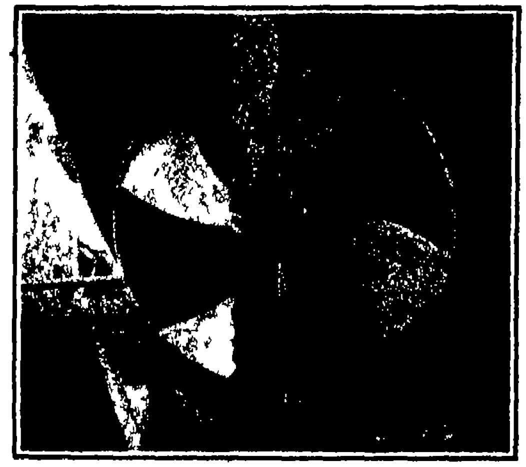
By Our Berlin Correspondent

WHAT purports to be the largest and most powerful reflecting telescope in Europe has recently been constructed by the Zeiss firm of Jena, Germany, and installed at one of the principal German observatories, that of Neu Babelsberg near Berlin. This is surrounded by a huge cupola thirteen meters in internal diameter, rotating round its axis and comprising a slot three meters wide. Apart from the principal mirror 1250 millimeters in diameter, there are two auxiliary mirrors used alternately, according as the telescope is employed either on the Newton or on the Cassegrain system, the focal distance being 8.4 meters in the former case and 24 meters in the latter. Provision is made for visual and photographic observation as well as for spectroscopic work.

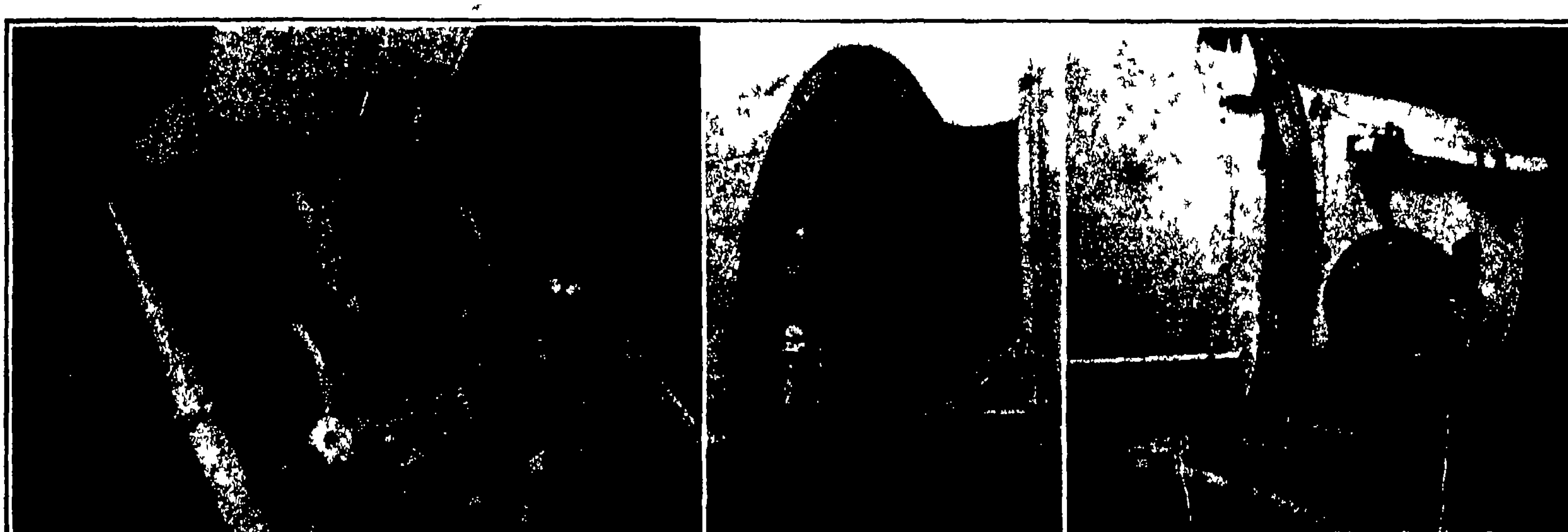
The auxiliary mirror used with the Newton system is fitted to the front end and into the axis of the tube by means of two steel bands in its interior. This is a plane mirror of elliptical outline (400 × 300 millimeters), the fitting and attachment of which with a spherical balancing weight is visible in the second picture below.

When arranged on the Newton system for photographic work, the adapter is fitted with cross-slide and two spectroscopes, thus allowing the daily motion of the instrument to be checked most accurately. This front end of the tube can be imparted any rotation round its axis by means of a hand wheel visible at the underside of the telescope, thus enabling the adapter arrangement and the searcher of 100 millimeters opening situated above to be readily attained by the observer. Electrical button switches visible to the left of the adapter control the fine adjustment of the instrument. There is also a mechanical fine adjustment independent of the other and simply actuated by means of a hand wheel.

The reflecting telescope is fitted with a double system of guiding and balancing axes. The balancing axes enable the movable parts of the telescope to be arranged sideways to the stationary column, thus allowing the telescope tube perfect freeness of motion in all directions.



The shrouded propeller, which throws all the water directly astern, without any divergence or centrifugal action



Left The double system of guiding and balancing axes *Center* The auxiliary mirror at the front when the telescope is used with the Newtonian arrangement *Right* The set up for photographic work showing the adapter with its cross-slide and two spectroscopes

Three views of Germany's newest and largest telescope, an all around astronomical tool of unusually wide range

Wooden rails in the Oregon lumber camps

Shrouding the Propeller

THE open type of screw propeller is an instrument whose principles of design have long been known by engineers. Today it is possible to predict the performance of a correctly designed open screw with remarkable accuracy, provided the performance is made under ideal or laboratory conditions. Such a propeller when mounted on a ship and sent to sea meets with varying conditions of weight, constantly varying draft, etc., so that it usually becomes necessary at some loss in efficiency to use a type of propeller which is the most economical compromise between the dictates of theory and of practice.

The shrouded propeller has been designed according to its English manufacturer to make its own conditions with the water. The shroud consists of a band fixed to the outer end of the blades, and this band has a fore-and-aft taper so that the stream produced by the propeller is confined. In addition the working pitch of the blades increases axially. Owing to these two facts there is a regular acceleration in the stream acted upon. A typical open propeller with a shroud fitted to it would not constitute a satisfactory propeller. It would be so large that it would overload the engine, the shrouded propeller usually being made 10 to 15 per cent smaller in its determining proportions than an open screw for the same installation. Again such a propeller would lose much of its efficiency. It is stated that the shroud of the new propeller takes the place of the surface of tearing and eddies which in the usual screw surrounds the stream of water directly acted upon.

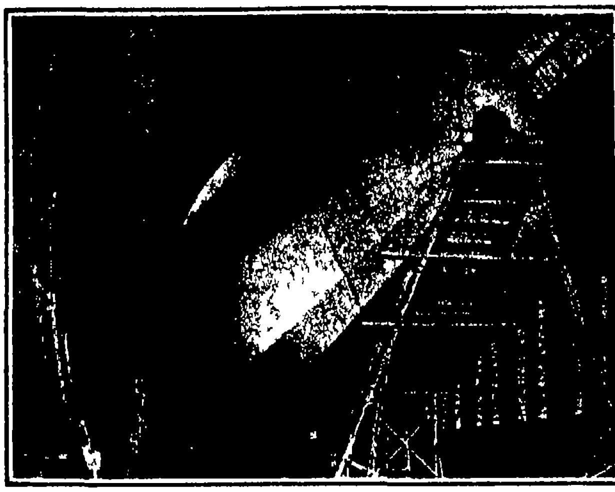
The distinguishing feature of this shrouded screw is that it causes all the water acted upon to be thrust astern instead of in a divergent direction, the latter effect being due to a centrifugal force. This introduces the subject of slip, and it is stated that a propeller whose advance through a solid nut would be about one and a quarter times that of the actual forward advance of the ship is generally speaking more efficient than one with less "slip." In this sense the shrouded propeller is less wasteful in attaining the requisite value of slip than are open screws.

Another advantage of the shrouded propeller is evident when working under very shallow conditions, for it is very much less likely to break water than the open screw. It also develops the merits of the broad tipped blade without incurring vibration. It obviates "squatting" at the stern and leaves a relatively smooth propeller wake, the latter being a very valuable attribute in the case of vessels operating in canals and other waterways of restricted area.

The commonest objection to the shrouded propeller is that the shroud occasions increased friction due to its drag. However, it is claimed that considerably more useful effect is produced by the shroud than is lost by its surface friction. Another objection frequently raised is that the shroud should be fixed with the propeller rotating within it. But such an arrangement would be unsound hydraulically on account of excessive eddy losses. In practice it has been found that if any solid objects it meets are too large to go through the opening, they are thrown off. In short, in meeting these objections the proof of the propeller is in the propulsion, and the shrouded propeller is stated to have produced towing results five per cent better than those attained with the best open propeller available.

Wooden Rails Where Wood is Plentiful

FURTHER confirmation of the rumor that there is nothing new under the sun comes to us out of the woods of Oregon. A large lumbering concern in the interior of this State, requiring short line logging railroads of a temporary nature on a rather liberal scale, laid these down using wooden rails. For this purpose big planks six inches square were employed, and the cars were equipped with solid rubber tired wheels, the flange effect being obtained by a separate inner wheel, of larger diameter and flat surface, bolted to the wheel that bears upon the top of the rail. We get the impression from the picture in the first column that these inner members do not reach the axle at all, overlapping the main wheels merely by a sufficient margin to carry the bolts, but of this we are not certain. Our introductory remark arises from the fact that the very first railroads, back in the days when Stephenson and his contemporaries were monkeying with the steam engine much as Olds and Haynes and others were monkeying with the gas engine in the early nineties, were laid with wooden rails—and they weren't any six inch square rails either. In fact the wooden rail goes right back to the days when the present function of the locomotive was discharged by the humble mule. Its use in the Oregon woods is therefore a reversion of much interest.



Bow view of "ZR 3," now near completion, which will fly from Germany to America this spring

Stern of the ship, showing strong construction of the fins. "ZR 3" is to be used purely for passenger and light freight service

Largest and Fastest of the Zeppelins

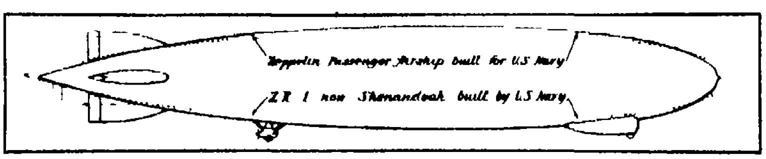
New German-Built Airship for the Navy, Soon to Set Sail for the United States

THERE is now approaching completion at the works of the Zeppelin Company at Friedrichshafen an airship, known for the present as "L Z 126," which is to become the property of the United States as part of the reparation payments. The ship has been built to the limit of size imposed by the Allies, that is to say, it is not to exceed in size the largest of the Zeppelins built during the war. Although the lines of the ship are similar to those of the latest wartime Zeppelins it contains some modifications suggested by the operation of two passenger ships, the "Bodensee" and "Nordstern," which were built and operated in Germany after the Armistice. It is the largest airship in existence. It has a capacity of 2 472 000 cubic feet of gas; the length over all is 656 feet and the diameter amidships is 90 feet. One of the conditions imposed by the Allies when this ship was turned over, was that she should not be used for war purposes. Hence she will be delivered to our Navy Department with the understanding that she will be used only for the development of commercial aviation and in experimental work to promote the general advancement of airship construction and navigation.

To enable our readers to judge for themselves the difference in the size and form of the two ships we present a drawing in which the profile of one ship is placed over that of the other, "Shenandoah" being shown in dotted lines and the new ship in full lines. It will be noticed that the new ship is of blunter form, and is more completely streamlined, that is to say there is no section of the hull where the hull is not curved, the streamline form running unbroken from stem to stern. She is 24 feet shorter than the "Shenandoah," but is larger in diameter by 11¼ feet. The fins and vertical and horizontal rudders are placed relatively further forward, and their construction is noticeably more rigid.

The framework of the new ship is similar to that of the "Shenandoah" as described and illustrated in our February issue, and the material of construction is an aluminum alloy somewhat similar to the duralumin of which the "Shenandoah" is built. The polygonal frames have 24 sides and the whole skeleton consists of alternate main frames with intermediate subordinate frames. The main frames are braced with wire cables and they are tied together with the usual longitudinal girders. The outside covering of the hull consists of a cotton fabric whose thickness varies according to the stresses at the particular part of the hull where it is employed, and it is "proofed" with several coatings so as to give it a smooth surface. The paint used contains a certain amount of aluminum powder which serves to give the hull the dull glistening effect that renders an airship when aloft such a truly beautiful object. The most striking novelty, at least to the Americans who have seen the military airships "R 34" and "Shenandoah," is the large passenger and navigator car which is attached to the underside of the hull some 90 feet from the extreme point of the bow.

Unlike the cars of the two airships above mentioned which are supported some distance from the hull by struts and wire cables, the framing of this car is riveted or pinned directly to the framing of the ship and therefore may be considered as forming an integral part of the main structure. We present an enlarged plan and a longitudinal section of this car, which is about 75 feet in length by 17 feet in width



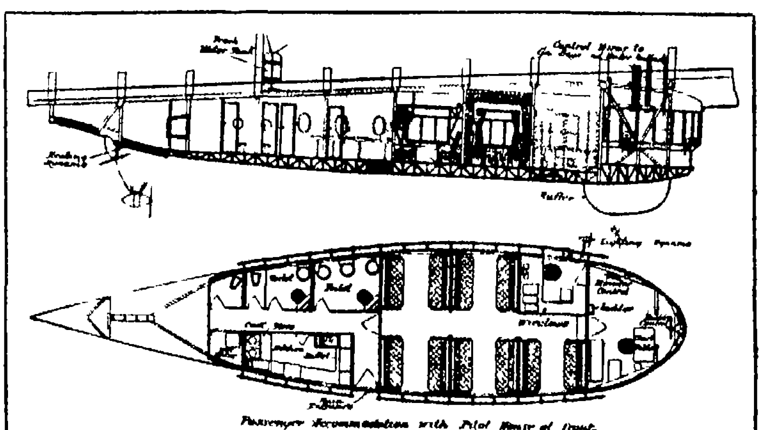
A comparison of the outlines of the "Shenandoah" (dotted lines) and "ZR-3" (full lines). "Shenandoah" measures 78¾ feet by 680 feet. "ZR-3" is 90 feet by 656 feet

at its largest diameter. It is strongly constructed of built up aluminum girders similar to those used in the main hull and these girders are rigidly attached to the main and secondary frames of the ship. Forward in the bow of the car is the Captain's cabin or navigating room, whose interior resembles somewhat that of the control car of the "Shenandoah," as shown in our February issue. Forward is the steering wheel with the compass in front. The elevator control is to the left, and on the opposite side is a chart table. Passing through a door in the after bulkhead of this compartment, one enters a central passageway which leads through the full length of the car. The first compartment on the right is the radio room, which is entered by a door connecting with the navigating room. Astern on either side of the passageway are the seating arrangements for passengers, which are generally similar to those found in a Pullman car. The seats are so arranged that they can be made up to provide upper and lower berths and there are curtains which can be drawn to provide the necessary privacy for each compartment. Abaft this section and shut off from it by a doorway are several toilet rooms, while on the opposite side of the passage is a buffet, kitchen, etc. The car is heated by means of a propeller-driven dynamo carried on a hinged strut, which is lowered when the heating of the car is necessary, and can be drawn up against the body of the car and out of the way of the airstream when heat is not required.

The motive power of the new ship is the largest ever installed in an airship, and it consists of five 12-cylinder, Maybach engines specially designed for airship service. Each engine is carried in its own enclosed and streamlined car. Four of them are mounted on opposite sides of the keel and the fifth is carried aft immediately below the keel. Each motor develops 400 brake horsepower at 1400 revolutions per minute, giving a total of 2000 horsepower for the ship. The engines can be reversed, and the reversing and starting gears are both operated by compressed air. The Maybach motor achieved a great reputation during the war and the experience thus gained has been incorporated in the present motors, which differ from the war motors chiefly in their ruggedness and strength. All motors are directly connected to the propeller. The notable difference from the war type is that, here we have twelve cylinders arranged in V form. Each cylinder has one inlet valve, two exhaust valves and two spark plugs. There are four Maybach carburetors carried between the two rows of cylinders. Boch magnetos are used, and the ignition works in either direction of rotation. The engines are started by compressed air, and it is claimed that a large starting movement is secured on a very small consumption of air.

The fuel tanks are divided into working and storage tanks, the former feeding by gravity. The storage tanks can carry a total of 17 tons of fuel. For the journey from Germany across the Atlantic to America, 30 additional tanks are being provided.

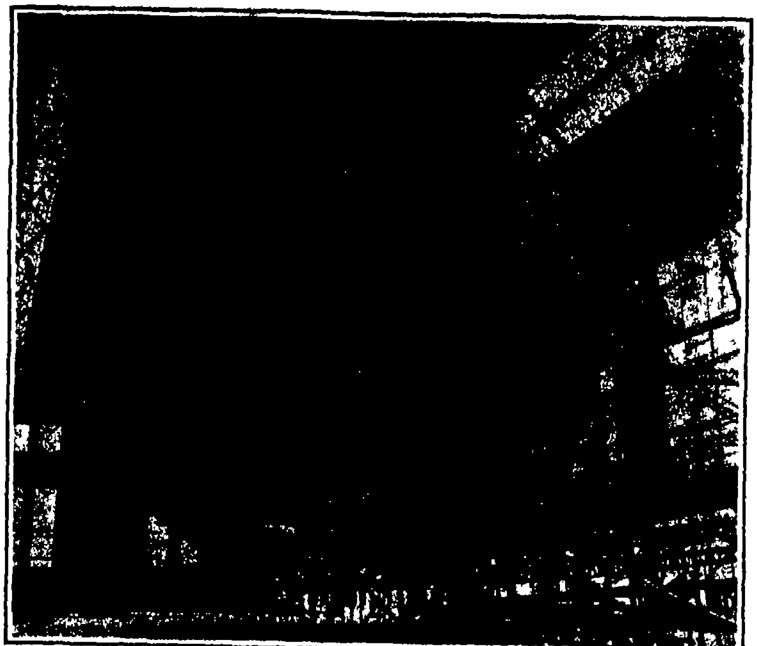
The accommodations for the officers and men include a cabin for the Commander, two sleeping cabins for the officers, an officers' saloon with dining accommodations, six sleeping cabins for the crew, two saloons for the crew, and two sets of lavatories. The whole of this accommodation is provided within the hull along the sides of the central corridor which runs the full length of the ship.



Plan and section of the car containing the pilot house and the passenger accommodation

All of the cooking, both for passengers and crew, is done electrically, and it should be added that in addition to the accommodations for officers and crew contained within the ship provision is also made for baggage, mails and cargo in 20 compartments arranged along the length of the central corridor. With the barometer at 760 mm the air and gas temperature at 0 degrees Centigrade the air at a humidity of 60 degrees, and the vessel charged with two and one-half million cubic feet of hydrogen having a specific gravity relative to air of 0.1 the weight and carrying capacity of the new airship, as given by the builders will be as follows:

Lifting effort, 89.6 tons; gross weight 45.5 tons; useful lift, 44.1 tons; speed at full power, 75.8 miles per hour; normal speed, 5 engines 67 miles per hour; speed 4 engines, 62 miles per hour; speed, 3 engines, 56 miles per hour; radius of action 5 engines full power for 46 hours 3480 miles; radius of action at cruising speed for 78 hours, 5121 miles.



This view of a midship section shows the framing, the system of wiring and one of the gas bags inflated with hydrogen

The Food of Corals

ACCORDING to Dr. T. W. Vaughan of the U. S. Geological Survey, the builders of coral reefs and islands are entirely meat-eating animals. In experiments conducted by him in the Tortugas in the Gulf of Mexico corals persistently refused a vegetable diet but even water fleas were not swift enough to dodge the tentacles of these carnivorous creatures.

The living coral is a branched colony of individuals all connected together and having their soft bodies encased in strong cells. Each individual is little more than a stomach, with a mouth surrounded by tentacles and sheltered in a little cup of the limy skeleton within which the whole colony is enclosed.

Dr. Vaughan describes how when a little beef juice or a small bit of meat, usually crab flesh or fish was offered the tentacles at the outer edge of the colony would begin to appear. Then the stimulus was transmitted to other members of the colony until the surface of the specimen had opened out like a beautiful flower. This condition seems to indicate that the coral colony is hungry and ready to capture food.

Corals have special mechanisms for catching food including tentacles containing stinging cells and cilia, or hair-like extensions of the outer layer of the soft tissue which in response to certain stimuli beat toward the mouth opening and in response to others beat away from it. The outer surface also secretes mucus in which particles of food may be embedded and this mucus is moved by the beat of the cilia either toward or away from the mouth.

Many different kinds of food were offered the corals but they took only animal food. A piece of diatom meat was placed on one side of the oral disk between the tentacles and the mouth, and a piece of crab meat on the other. Invariably the crab meat was seized and swallowed while the diatoms induced no reaction except ultimately to be removed from the surface. No kind of purely vegetable food was taken by any one of the numerous species investigated.

When hunger is entirely satisfied the tentacles retract and the ciliary motion reverses and particles of food are moved away toward the outside edge of the colony.

At the rate of upward growth observed in the reefs of the West Indies it would take from 6531 to 7620 years for the formation of a reef 150 feet thick in one of the species examined while another could build the same thickness of reef in 1800 years while some of the Pacific forms grow still more rapidly and might accomplish as much in 1000 years.

Filter-Passers: Living Beings Smaller Than Bacteria

IT seemed to the pioneers who first sighted the bacteria—those minute fungi distant cousins of the breakfast mushroom—that they had attained their goal and that life could not live in narrower confines. Yet today we hear of living creatures far smaller than most bacteria but of even greater importance in the havoc they work to the human race. To this group of living morsels has been given the name of "Filter-passers" and although they have baffled research from the time of Pasteur to the present, it would seem that now at least we are beginning to understand more about them.

Among the diseases believed to be caused by them are first and most important in its universality influenza but smallpox, hydrophobia, scarlet fever and measles are also attributed to the same group of organisms as are foot and mouth disease in the animal world and distemper in dogs. Even the plant world suffers from them for mosaic disease in tobacco plants is due to them. All these diseases are very infectious—infinitely more so, for example, than the bacterial disease typhoid fever which can only be contracted by eating infected material or injecting bacteria.

The size of a filter-passer is emphasized by the property from which it has derived its name—the power of passing through a filter. The filters used by the careful housewife to purify her water supply, and by the bacteriologist to rid the fluids with which he works of bacteria are of two kinds. The Berkefeld filter is made by compressing an earth which consists of the flinty skeleton of a microscopic plant known as a diatom—an earth which is also used as a tooth powder. It has been estimated that particles as large as a five thousandth part of a millimeter can pass through this filter in some instances. The second kind of filter, the Chamberland, is made of unglazed porcelain and has much smaller pores. Any particle which passed through it must be smaller than a twenty thousandth part of a millimeter.

Every filter-passer can pass through a Berkefeld filter; some can negotiate a Chamberland and one has been described—the organism responsible for mosaic disease in tobacco plants—which is even said to be able to diffuse through gelatine.

Filter-passers however are not too small to be seen. The trouble is that when a fluid such as a nasal secretion from a dog with distemper is looked at by these special means so much is visible that it is not possible to distinguish the filter-passer from other unimportant particles.

Even a bacterium is not easy to identify if examined in a state of nature. It must first be stained with aniline dyes and the aniline dyes themselves consist of relatively large particles. Staining filter-passers has therefore not proved helpful—the particles of dye and the organisms themselves are too nearly of the same size.

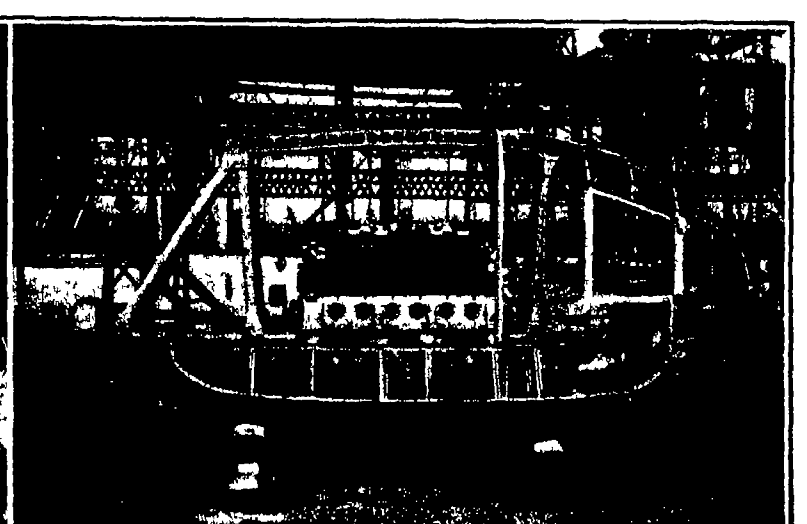
On the other hand in distemper, influenza and rabies, to mention only a few diseases, the objects seen do not resemble bacteria. They are tiny specks—that is all that can be said of them.

How then do we know that these little objects are alive? And if alive how can we be sure that they cause the disease?

Life is always difficult of definition. The answer is that one very significant property of living matter is its power of reproduction and that on the establishment of that feature in filter-passers the whole theory of their nature rests.

If we can grow the filter-passer, take a tiny morsel of the growth and grow it again and again on suitable soil, we prove that it is reproducing itself and is alive. Volpino, an Italian scientist, has grown the filter-passer which causes cow pox. Noguchi, a Japanese bacteriologist, was the first to grow a filter-passer in 1913—the organism of infantile paralysis.

The ship can carry 17 tons of fuel. Here we see a dozen of the tanks suspended within the keel structure. Thirty extra tanks are provided for the ocean trip



One of the five engine cars. Each carries a 12-cylinder, Maybach engine of 400 horsepower. Maximum speed, 75 miles per hour

Our Abrams Investigation—VII

Queer Adventures and Queer People Met in Our Quest of the E. R. A. Truth

By Austin C. Lescarboura

Secretary of the SCIENTIFIC AMERICAN Abrams Investigation Committee

VISUALIZE, if you will, a darkened room; a boy, naked from the waist up, standing in the center of the room on a pair of metallic plates, and wearing about his head a rather impressive strap which carries an electrode; a collection of crude electrical apparatus on a nearby table with a maze of wires; a grave diagnostician sitting in front of the boy and stroking the latter's bare abdomen with a glass rod. A small piece of blotting paper containing a tiny blot of blood has been placed in a receptacle known as the dynamizer, and a horseshoe magnet has been brandished over the various parts of the apparatus and over the headgear of the youth. The switches on the apparatus have been set to a certain point, as accurately as their flimsy construction permits.

Presently the rod seems to stick or grow heavy over one portion of the youth's abdomen. The diagnostician glances at the setting of the switches, and calls out to the assistant standing with pad and pencil: "Diminished resistance 18 ohms." The crude switches are adjusted again. More stroking of the abdomen. "V. R. 55 plus 6," which translated into your language and mine, means the so-called vibratory rate of 55, representing acquired syphilis, 6 ohms. A new setting of the switches. More stroking. "V. R. 42, 3 ohms," which translated means vibratory rate 42 or tuberculosis, 3 ohms. And so it goes. Lest we make any mistake about it, let us be reminded that these diagnoses apply not to the young man who submits to the caresses of the glass rod, but to the person from whom the blood in the dynamizer was taken.

Were it not for such high sounding terms as vibratory rate and ohms, we might take this entire scene to represent the medieval alchemist at work. Or again it might go well as a ritual of some savage tribe intended to drive away evil spirits. Certainly it does not fit in with the present age—the age of the electric light, radio, X-ray, phonograph, steam engine, wonderful machinery.

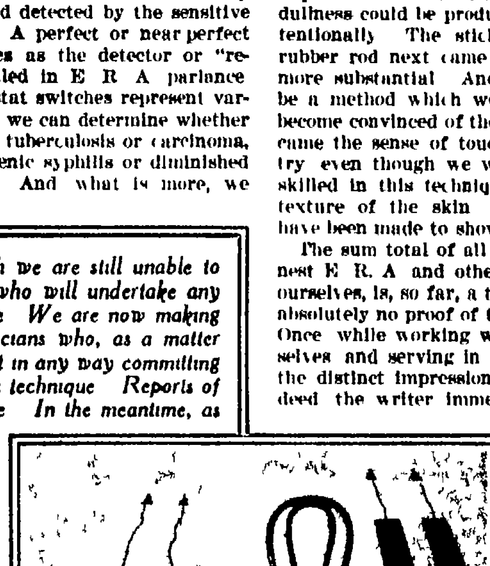
Yet here is a diagnosing technique which has been gaining ground. Here is a method of learning what is wrong with suffering humanity which has been gaining popularity during the past few years, ever since one Albert Abrams, a well known doctor of San Francisco, announced to the world his discovery of the radio-activity of human blood and a new method of diagnosing and combatting disease. Here is a method that has been espoused by numerous doctors and near doctors who have abandoned their *materia medica*, in which they had such faith in bygone days.

From one end of this big country of ours to the other we have these abdomen strokers at work. Most of them are working in the open, quite proud of their mastery of the new technique. They call themselves E. R. A. practitioners—Electronic Reactions of Abrams practitioners when given in full. Then, more startling still, we have many physicians engaged in this abdomen stroking in the obscure corners of their offices and homes, far removed from the prying eyes of the world at large. These are the men who hesitate to connect their names with the E. R. A. movement, yet have come to believe that, after all, in the deepest intricacies and all but hopeless inconsistencies of this entire mess, there may be something fundamentally true and highly important. Many a dignified doctor has an Abrams outfit concealed somewhere about his establishment which engages his spare moments and gives his already tired mind plenty to think about. Again, there are men of wealth and with adventurous minds, hard at work with the E. R. A. apparatus, endeavoring to find out what this crude stuff really does and how it does it. They are spending tens of thousands of dollars in this work, hoping, perhaps against hope, that here we may have the whole secret of that intricate thing which we call health. Then, too, we have electrical engineers and physicists, men whom we have come to look upon as cold calculating mentalities, dabbling with the E. R. A. technique—dabbling, we say, because they cast aside all their cold calculating ways when they work in E. R. A. methods and accept the most obvious piffle which even the untrained layman would refuse to take seriously.

The adventures of Alice in Wonderland are tame in comparison with those of an investigator in the land of E. R. A. We are prepared to make due allowances for the fiction of the former, but when it comes to the latter we are dealing with the cold realities of 1924 A. D.

What does it all mean? In brief, we are told that Dr. Albert Abrams, recently deceased, discovered that human blood, even so little as a drop of blood, gives off radio-active emanations or waves of some sort, and that these emanations or waves can be tuned in by means of crude rheostats and detected by the sensitive nerves of the human body. A perfect or near perfect specimen of humanity serves as the detector or "reagent," as he or she is called in E. R. A. parlance. Various settings of the rheostat switches represent various disease values, and thus we can determine whether the blood specimen gives off tuberculosis or carcinoma, malaria or sarcoma, cryptogenic syphilis or diminished resistance, only, and so on. And what is more, we can also determine the quantity of each disease in the drop of blood, although all the while the patient whose blood is being tested may be thousands of miles away. The late Albert Abrams went even further than the mere testing for diseases. His clinical reports told of how he could determine the religion and racial strains of the blood and detect such matters as a will to deceive, an incipient love affair, and other deeply rooted human emotions. At a pinch the blood specimen could be done away with, and in its place a specimen of handwriting could be used in diagnosing the case by proxy, as it were.

OUR Abrams investigation, though we are still unable to find any electronic practitioner who will undertake any sort of a set test, proceeds apace. We are now making systematic tests with independent physicians who, as a matter of possible scientific interest and without in any way committing themselves, have mastered the electronic technique. Reports of these tests will appear in an early issue. In the meantime, as the seventh installment of the series which started last October, we describe here some very damaging performances given in our presence and out of it by electronic practitioners who were rash enough to attempt the, apparently less incriminating, "demonstration" of their technique.—THE EDITOR



Typical E. R. A. diagnostic equipment set up and ready for use. The reagent stands on the left ground plates, facing due west, with the proximal electrode on the forehead

All of which hinges on one fundamental claim. When the electronic energy or whatever it may be flows from the blood specimen or handwriting specimen through the rheostats and to the human detector it is said to cause changes in certain areas of the abdomen in which case the reactions, as they are called, make known their presence by a dulling of the percussive note. Again, if a glass or hard rubber rod is rubbed over the proper areas, it will stick or become heavier when the reactions take place, so it is claimed. Still again, the reactions may give rise to a certain roughness of the skin which can be detected by the sensitive finger tips of the skilled E. R. A. diagnostician, so it is said. Finally, we are assured the reactions may cause the proper areas to blanche or whiten, so as to form a marked patch quite distinct from the pinkish appearance of the rest of the abdomen.

It is on these reactions in the reagent or human detector that this entire E. R. A. technique rests. Time and again Dr. Abrams and others have endeavored to work out electrical or mechanical substitutes for the human detector, but nothing so far has been found as hyper-sensitive as the human nerves. So no matter how elaborate may be the diagnostic equipment, no matter how impressive may be the charts and curves presented by many so-called electronic investigators, the foundation is always the mysterious reactions in the human reagent or detector.

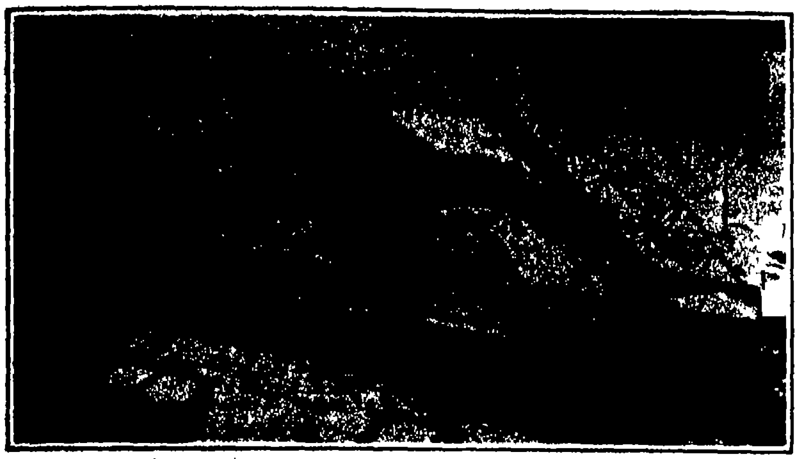
For six long months the Scientific American Abrams Investigation Committee has been seeking objective proof of these reactions, fully realizing that here was the true starting point of the entire matter. Early in our investigation we came face to face with the percussive method of eliciting reactions, but were not deeply impressed because of the ease with which the effect of dullness could be produced, intentionally or quite unintentionally. The sticking of the glass rod or hard rubber rod next came to our attention. This seemed more substantial. And, what is more, this seemed to be a method which we might try ourselves, and thus become convinced of the existence of the reactions. Then came the sense of touch method, which we could also try, even though we were assured that one had to be skilled in this technique to feel the difference in the texture of the skin. On several occasions attempts have been made to show us the blanching of the skin.

The sum total of all these efforts on the part of earnest E. R. A. and other electronic workers, as well as ourselves, is, so far, a total failure. We have been given absolutely no proof of the occurrence of these reactions. Once, while working with other investigators like ourselves and serving in the capacity of reagent, we had the distinct impression that we felt the reactions. Indeed, the writer immediately notified several leading E. R. A. men to that effect. Upton Sinclair, in his latest article, mentions that fact, which only goes to prove once more that this investigation, first, last and always, is sincerely intended to get at the truth. However, subsequent experiments and tests with the same men, as well as stroking our abdomen with a plain stick in the quiet of our home, without extraneous influences of any kind to produce reactions, caused us to decide that the reactions originally felt were merely the reflex action of the sensitive solar plexus when subjected to the heavy pressure of the rod. We use the term "heavy" advisedly. No gentle tickling is the treatment to which the electronic reagent submits, but a decidedly vigorous massage. A colleague possesses sensitivity of the abdominal nerves so extreme as to amount to a family joke, and he found the attempt to act as reagent so punishing that he was forced to abandon it in short order. It does not seem possible that such vigorous application of an external stimulus can be without its reactions, apart from anything electronic or otherwise mysterious.

Do these reactions really take place? Or are they nothing more than a bald fake? Both those questions have received our careful thought, and our observations have been directed toward answering them. At present we are prepared to state tentatively, always reserving final judgment in the event that we are given proof which would cause an immediate change of opinion, that the reactions are not objectively real, that is to say, they cannot be detected in any way by any person other than an E. R. A. diagnostician or one with strong E. R. A. convictions. They cannot be demonstrated to a person of an open frame of mind, just as certain psychic phenomena fail to impress the average person. Even the great Abrams insisted that the will to believe was a prerequisite in this work. Very significant, that!

Yet we are led to believe that the reactions are not a bald fake. They could be readily faked, true; but there is sufficient evidence that the usual E. R. A. diagnostician firmly believes he is getting the reactions. Whether he is percussing, stroking, feeling or seeing,

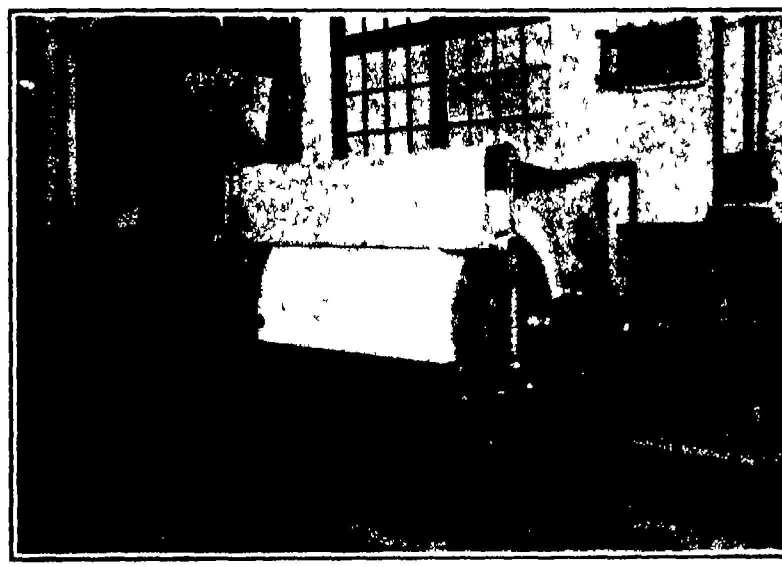
(Continued on page 278)



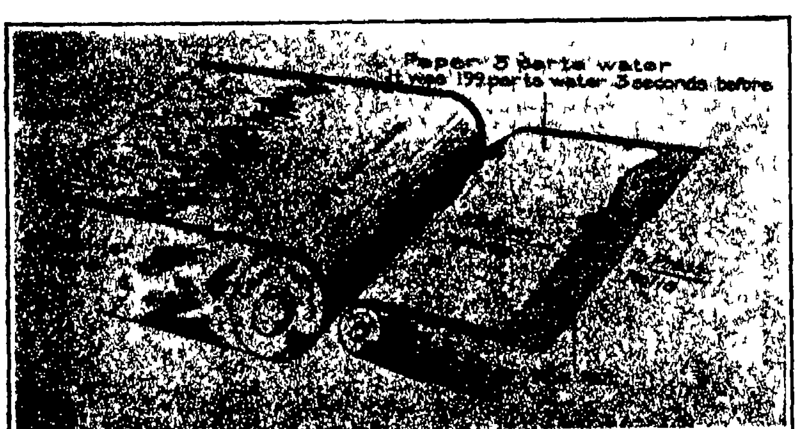
(1) In summer all the wood necessary for current consumption as well as for the coming winter is floated down the river or brought in cars from the forests The logs float down the rivers and each mill takes out its own logs by impounding all the logs and then letting those of other mills pass out through so-called 'sorting gaps. The logs are 12 14 or 16 feet in length These logs are taken as required and cut into four-foot lengths by means of saws in what is called the slasher mill The sticks" are either used immediately, or are led to the stacker which piles them in the huge storage pile such as this one containing 80 000 cords

(2) The logs still having their bark are led to the barking mill as shown in this view here to have the bark removed This process involves the use of three drums made in sections that are bolted together Each drum is 46 feet long and 12 feet in diameter The drums revolve at the slow speed of seven revolutions per minute and each drum requires 150 horsepower to drive it. The logs introduced at one end of the drum are tumbled about to wear off the bark and then ejected clean from the other end to be carried to the wood pile or to the chip mill or the ground wood mill for current use.

(3) Ground wood is produced by forcing the wood against grindstones each weighing 10,000 pounds. The small logs are fed into a reservoir in an upper story of the mill and are forced against the grindstone rotating at 240 revolutions per minute Water is freely used not only to remove the ground pulp-wood, but to prevent burning and over-heating the grindstone so that it will not burst A hydraulic cylinder forces the logs against the grindstone After the wood is ground it is known as 'ground wood or ' wood pulp It is then ready to be mixed with the sulfite pulp to form the mixture from which paper is made



(4) About every three hours the grindstones must be resurfaced so that they will not become glazed and thus lose their grinding efficiency There are two kinds of woodpulp which enter into the manufacture of newsprint One is mechanical pulp made by grinding wood into pulp against revolving stones as already shown The other is chemical pulp made by cooking the wood chips in dilute acid baths under pressure The chemical pulp known as sulfite is the one used in combination with ground wood in the manufacture of newsprint A pulp mixture of about 1 per cent pulp and 99 per cent water is now prepared and delivered into the head box placed at the head of and across the full width of the paper machine



(5) From the head box the dilute pulp is allowed to flow evenly onto an endless wire belt made of fine copper or bronze wire meshed from 60 to 70 to the inch. The endless screen of wire moves forward with a lateral oscillating movement down a slightly inclined plane at a speed as high as 1000 feet per minute. The movements spread the pulp evenly for more uniform matting or felting' of the fine fibers as the water drains away through the wire, leaving a deposit of interlaced and commingled fibers in the form of a wet sheet Suction boxes along the path of travel suck out still more water. Finally the pulp sheet leaves the wire screen to pass between two rolls called the couch rolls," as shown here. The upper roll (not shown) is covered with felt and gently squeezes more moisture out of the sheet against the lower roll At the conclusion of this process the watery pulp has been changed into paper

(6) And here we reach the paper machine through which the damp sheet now runs on a woolen belt from the wire screen on through a series of press rolls which remove much of the remaining moisture At this stage the sheet of paper still contains from 65 to 70 per cent of water The sheet now passes over a long series of heated iron cylinders which dry the sheet It then passes over a vertical stack of smoothly finished steel rolls of smaller diameter called calenders, which virtually iron the sheet smooth This machine in the plant of the International Paper Company at Three Rivers Province of Quebec measures 277 feet long and makes 950 feet of paper measuring 152 inches wide in one minute The paper is too wide for the requirements of commerce hence it is reeled at full speed and is afterward taken by the winder to be cut and wound into hard rolls which are wrapped and shipped to the hungry presses of the publishing world

FROM LOG TO PAPER: A BRIEF VISIT TO A GREAT NEWSPRINT MILL IN CANADA

Saving Dollars by Salving Scrap

How the Multitudinous Wastes of a Great Railroad Are Converted Into Cash Values

By Charles W. Geiger

The rail straightener in the Southern Pacific reclamation plant

MODERN railroad efficiency methods are well exemplified in the way the Southern Pacific Railroad Company avoids waste in the use of materials by the utilization of what was once discarded as worn out and useless. Many parts that might have acquired a new lease on life through very little attention were formerly relegated to the scrap pile. Wastefulness was accepted as a matter of course and it took a keen sense of personal responsibility to overcome the deep-rooted habit. The actual custodians of the company's property are the employes and whatever benefits one also benefits the other. A conscientious employe exercises care in removing and replacing parts to avoid breakage, does not abuse the tools or machines on which he is working and endeavors to get maximum service out of every article the company furnishes. In other words he cooperates.

Much of the material collected by the supply trains is not scrap at all but merely slightly worn or deformed, so as to be unserviceable. Specialization in this work has created and built up an important department, the sole object of which is reclamation. The Southern Pacific Company (Pacific system) during 1921 would have had to draw $872,000 from its treasury to purchase new the volume of material reclaimed in that year. The company saved $735,500.05 on its Pacific System during 1922 through the accumulation and reclamation of worn and discarded material.

As reclamation was an entirely new field it was necessary to construct special machines adapted to the work to be done. For this purpose scrap parts were used and the apparatus entirely home made. A bolt straightener, for example, was made out of an old wheel boring mill that had been broken and scrapped. The crooked bolts or bent rods are inserted between the V shaped jaws which alternately open and close. They are adjustable to take any diameter material from ½ inch to 1¼ inches. Material is fed into the jaws a few inches at a time and rotated, appearing on the opposite side straight. The bolts are cut to length in a home-made alligator shear, and rethreaded.

A nut remover of novel construction is being used. The shank of the bolt is gripped in the vise jaws while the nut is forced into the bell mouthed chuck which rotates in a left hand direction. As soon as the nut is free of the bolt it drops out of the chuck. One chuck will handle three different sizes of nuts.

Pipe fittings, track bolts, nuts, etc., pass through a "rattler." The revolving drum is one-third submerged in distillate which in the course of twenty minutes thoroughly removes dirt and scale. The drum is then lifted by a small crane and the contents dumped onto a sorting table which is inclined so that the distillate drains back into the tank. While one charge is being rattled the preceding one is being sorted into trays according to size and kind. Gages are provided but experienced operators rarely need to use them. Nuts are retapped on a six pointed tapping machine, washers and other small parts are ready for use without further attention. The distillate not only cleans and brightens the parts but acts as a preservative against further rusting.

Track spikes are handled through an oil furnace by gravity, being dumped into a hopper and fed through the furnace as rapidly as they are extracted from the bottom. While hot the spikes are dropped into the home-made straightening press. If the heads are out of alinement they are given a light blow with a hammer. The press is double-acting so that the instant the finished spike is released the center block starts compressing the spike just dropped into place on the opposite side, thereby saving air and increasing production. This machine straightens 2000 spikes in an eight-hour day.

A grinder for refacing the steam joint of Klinger water glasses consists of an abrasive disc which slowly rotates the outside edge of the disc being slightly eccentric. Six glasses are mounted with bevel side downwards in the small holding clips which are weighted by the hinged load on the back of each. The eccentric above referred to actuates rollers, which transmit motion to the glasses causing a swaying movement of fifteen degrees thereby eliminating wearing grooves or ridges. No abrasive is used other than the glass itself, and water. The output of this machine is eight glasses per hour and the machine once in motion requires no further attention.

A machine has been devised to strip scrapped dry cells. The zinc and brass removed are sold for scrap

Rattler for cleaning fittings against possible re-use

and the wax is made into sealing wax. While the saving in this instance is not large it more than pays for labor and other costs and keeps the right of way clean of such rubbish.

Superheater units are reclaimed by renewing the return bend or applying new ball joints. The bends are formed out of scrap and are welded on to the extremity of the unit making one continuous pipe. The ball joints are turned out of bar stock. A projecting lip engages the end of the unit pipe holding the work central during the autogenous welding process. The unit joint is finally polished with a carborundum cloth, held in a cup-shaped chuck, attached to an air motor. Gages are used on all points and seats to insure proper contour. When finished the unit is tested to 250 pounds hydraulic pressure.

The foremen and employes in charge of this vast field of reclamation are continually striving for new and better methods of handling this work and of adding to the great savings which have already been accomplished. They have a well merited pride and satisfaction of accomplishment which comes to all those who are making "two blades of grass grow where one grew before."

In many instances material discarded by one department of service is used by another department by means of which large savings are affected.

Scrap carpet is used for making covers for foot rests, dust guards and hand protection pads for employes in rolling mills, foundries and scrap docks.

Scrap rope is unwound and used for binding company shipments in place of twine.

Sediment from acetylene generators is used in place of lime for whitewashing purposes and in place of lime in the steel foundry.

Tarlene, a by product of Pintsch gas plants, is used for painting underframes of cars, displacing the high priced paints which were formerly used for this purpose.

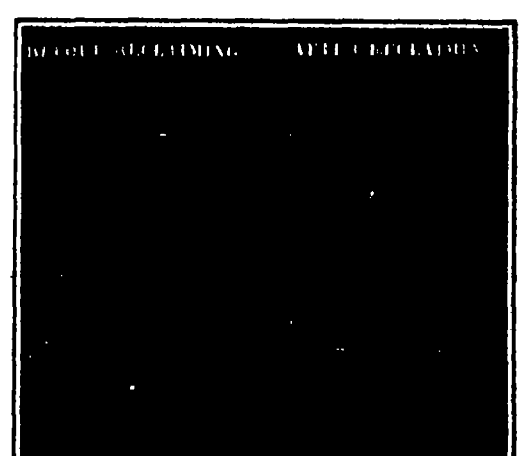
Scrap car roofing is made into tinware, smoke jacks, ventilators, shop lockers, etc.

Scrap boiler tubes are used for a number of purposes. When threaded or butt welded together they are used for water drain lines (after dipped in hot asphaltum), for air lines, conduits, etc., for manufacturing of locomotive pilots, in making freight car ladders, and in making washers by flattening out and punching, two washers being made by one operation.

Ball Lightning

IN a recent address before the Institution of Electrical Engineers (British) Dr. G. C. Simpson discussed the question of "ball" or globular lightning. Dr. Simpson came to the conclusion which is now very generally held that this is a real natural phenomenon. He summed up the characteristics of ball lightning as follows: the body or ball itself, which is able to retain its individuality as it moves through the air, appears to be composed of gas or matter in some novel luminous condition. The balls appear to exist independently of any large electrical intensity, for they have been observed within closed rooms where large electrical fields are impossible and have also been observed to pass in and out of parallel telegraph wires. They appear to be associated directly or indirectly with large quantities of energy, for they have been observed to explode with violence, and have also been seen to fuse the overhead wire of an electrical tramway.

No satisfactory explanation of ball lightning has, however, been offered. Dr. Russell says: "Globular lightning seems to be a brush discharge taking place at the end of a column of air of higher conductivity than the neighboring air." He then points out some of the difficulties of this explanation to which others can be added. In fact, there is really nothing very similar between a brush discharge and the ball of glowing gas so frequently described. The only physical phenomenon yet produced in a laboratory at all approaching ball lightning is the active nitrogen studied by Lord Rayleigh. In this case we have a mass of nitrogen subjected to an electrical discharge which continues to glow for some time after it has been removed from the field. Lord Rayleigh however is unable to accept this explanation of ball lightning, and all that we are able to say is that active nitrogen is the nearest physical phenomenon to ball lightning yet produced in our laboratories. Ball lightning appears always to be associated with a thunderstorm, and it is possible that the intense discharge of a lightning flash can produce some atomic change in the air or rain through which the discharge passes. If this is so, the glowing matter of ball lightning which distinguishes it from others, may be in a state otherwise not met with in nature.



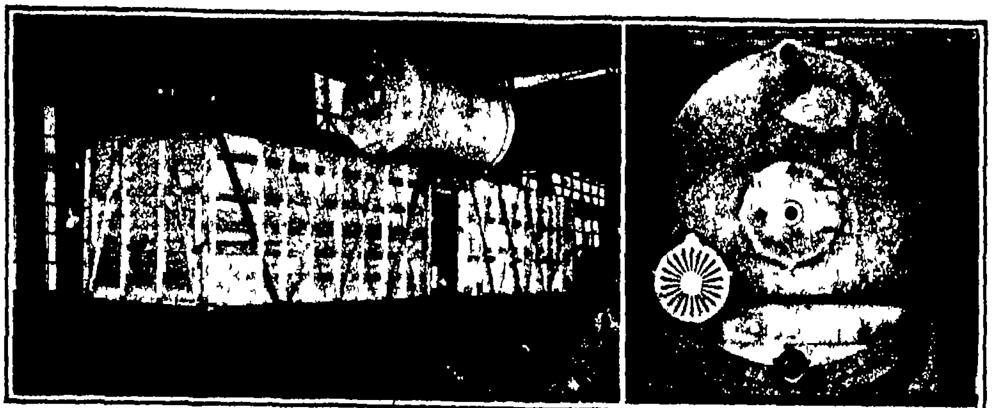
Some of the items that might have been junked, but weren't

Shipping Milk in Carload Lots

ORDINARILY milk reaches the railroad in tin lined cans carrying from ten to fourteen gallons, and goes aboard the cars in these same cans. The inconveniences and dangers of this system are too obvious to require cataloging. But in the absence of specially constructed tank cars designed for the transport of milk and nothing else, the milk can is an unavoidable feature of the shipment of milk.

A Chicago manufacturer now offers a car for milk shipments which is really a thermos bottle on wheels. Externally, it is an ordinary box car, forty feet long. Internally, it is two big tanks, end to end and occupying the entire length of the car, plus a brine refrigerating system. The floors are waterproof and are carried sufficiently high up the sides and ends to prevent water from getting down and rotting the under sills. Drains are provided so that the car may be conveniently flushed. The refrigerating system is such as to insure a uniform temperature throughout the car. Each tank is equipped with recording thermometer, motor driven propeller agitator, contents gage and other fixtures and the tanks are mounted in a three-inch bed of asphalt to control vibration. The capacity of the tanks is 3000 gallons hence of the cars, 6000.

An interesting feature is that in a full shipment of 6000 gallons, there is a gain in milk delivery of 600 to 800 pounds. This represents the milk that adheres to the inside of the cans and has to be lost in the washing process. With the tank cars the total adhesion is less than one quart. It need not be emphasized that the refrigeration is vastly more satisfactory. The tanks, by the way, are of enameled glass, which accounts for their low coefficient of adhesion.



Left The milk tank car in construction showing relative sizes of car and tank. *Right* End view of tank in car, with controls that record and regulate the temperature and the condition of the milk

Glass enameled containers for railroad shipments of milk, which put this commodity on the same satisfactory shipping basis as oil

Log Rafts in the Open Ocean

LOG rafts are almost as old as logging itself but it is not every day or even every year, that rafting is indulged in upon such a scale as that shown in the accompanying photograph. These three huge log rafts, tied together structurally far more closely than is the case when only rivers are to be navigated, have completed a 1500-mile voyage in the open waters of the Pacific ocean, from British Columbia to San Diego. They are cigar-shaped, upward of 900 feet long, and contain millions of feet of lumber. Lashed together with ponderous chains, each raft was towed by a sea going tug. The trip requires a month and is attended with all sorts of dangers. It is not unusual for the tug to be obliged to cast its tow loose, returning to pick it up in a calmer sea. The utter impossibility of the rafts sinking makes it permissible to do this more freely than in towing of the more conventional sort. Our photograph, taken from the air by a pilot of the U. S. Naval Air Station at San Diego, shows two of the rafts side by side, with the third partially broken up. Somewhat better conception of the amount of timber in each raft may be got from the latter than from those which are still intact.

Three 900 foot lumber rafts that made the trip from British Columbia to San Diego, via the open ocean

The Danger to Alfalfa

PROMPT and aggressive action to save America's alfalfa and other crops from tremendous damage from the eel worm disease is urged in an appeal issued by the United States Department of Agriculture through its well known and ever active Bureau of Plant Industry.

The eel worm is an organism scarcely a twentieth of an inch long when fully grown that causes a disease which shortens the life of the crop by several years, makes frequent plowing and replanting necessary and reduces the yield. Under favorable conditions experiments indicate that the alfalfa eel worm may injure red, white and alsike clovers, buckwheat, English peas, turnips and even potatoes, as well as alfalfa.

As many as 200 eggs may be laid by one eel worm, the young being about a tenth the size of the adults. Under moist conditions these migrate or are carried by irrigation water or other means to new plants. They penetrate the tender parts of these plants and grow to maturity within the plant tissues, causing swellings and abnormal growths.

Finally the parasites become so numerous that they completely kill the plant. When this happens they leave it and go into the soil to attack other plants that they may be able to reach. A poor stand of dwarf plants is frequently the result.

The presence of the alfalfa eel worm disease was first noted in America in 1921 when it was discovered in a single field in eastern Oregon. Since then it has been found more widely distributed in that general locality than was at first thought. It has been found in California and Colorado and it is considered possible that it may occur in other parts in the country. Efforts will be made by the Department of Agriculture to secure a complete survey of the entire country during the present growing season in order to discover all infestations and to eradicate the disease before it becomes too wide-spread and too generally established.

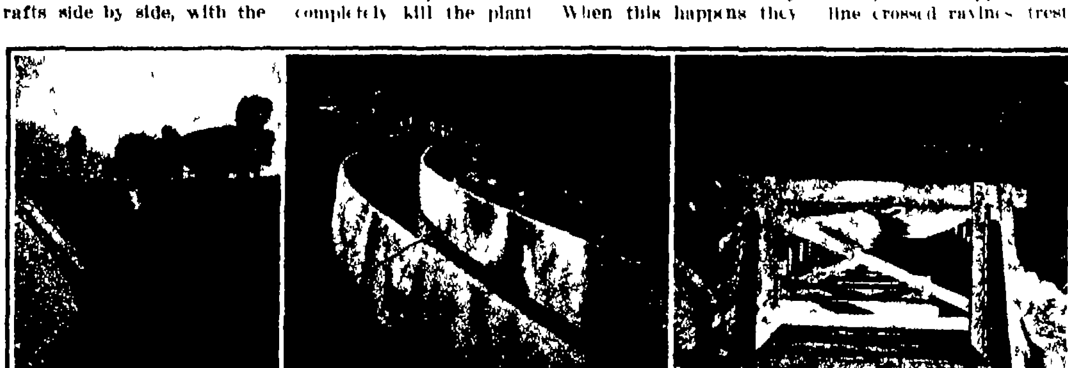
Building a Concrete Flume in Rough Country

A CONDUIT and flume line 2½ miles long was recently completed by the San Joaquin Light & Power Corporation on the north fork of the San Joaquin River in California by means of which the water supply serving a chain of six power houses was materially increased. The inaccessibility of the upper end of the conduit line and the fact that a grade for a flume was cut along approximately the same location in 1910 made it advisable first to build a construction railroad along this old line, beginning at the lower end which was reached by road and then to build the new conduit from the upper end down. With this plan a constantly advancing source of water supply was made available by admitting water from the upper end to completed sections of the conduit.

The original conduit built in 1910 to provide sluicing water for Crane Valley Dam, was a combination unlined ditch and wooden box flume with a capacity of 30 second feet. The flume and trestles were largely destroyed by forest fire. The new conduit line consists of concrete lined ditch, concrete box flume and riveted steel flume on redwood trestles, all with a uniform capacity of 100 square feet. Very careful figuring was required to make the new construction fit the old grade and at the same time to conform to uniform cross sections as far as possible. It was not advisable to change the section more often than absolutely necessary due to the additional cost and delays which such changes made in forms and reinforcing.

A construction headquarters was first established at the lower end of the line and a small warehouse and material yard were built there. An eighteen inch gage railroad with twelve pound rails was then constructed. Most of the ties were salvaged from what was left of the old flume and the track was laid alongside the old ditch, on the upper side where possible. Where the line crossed ravines, trestles to be used later by the steel flume were built first and the railroad was carried across on them. The trestles were built as the railroad advanced so that except for a small amount of cement used in the trestle footing no material had to be carried in on the backs of workmen.

The accompanying views show just a few phases of this interesting work. As will be seen from these photographs, the forms are used repeatedly, effecting a heavy saving in material and transportation costs.



Left The side dump car for pouring the concrete shell of the flume. *Center* A section of the completed flume. *Right* Forms and reinforcing in place ready for the pouring

Driving a concrete flume through the big woods with maximum economy

Little Fishes and Big Oil Pools

PETROLEUM is already one of the world's major sources of heat, light and power for production and transportation. It is also the source of supply for a thousand byproducts that have come to be of immense importance to civilization ranging from medicines through the field of dyes and chemicals to the asphalt residue which is used for road building and similar purposes. It is generally admitted that industry has not yet reached the limit of its uses, and each year the demand for its chief products—such as gasoline—is increasing far beyond the computations of a few years ago. In fact this increase brought about widespread apprehension that the supplies must be conserved, the fear that some day the world might exhaust its reservoirs of crude oil and that substitutes must be found.

In submitting his thesis that these fears are unfounded Dr. John M. Macfarlane of the University of Pennsylvania is not advising against conservation. On the contrary he is advocating it. But he would accomplish it by a more efficient use of the crude oil taken from the earth by complete utilization of all the byproducts now in many instances permitted to go to waste. He points out that such a system has made it possible to produce oil from surface shale in Scotland on a commercial basis. The world's largest deposits of shale oil are in the western mountains of the United States but heretofore there has been no exploitation of them except for stock selling purposes. Yet the quantity of oil in such rocks is almost beyond computation according to Dr. Macfarlane.

Perhaps the most startling feature of Dr. Macfarlane's claims is the assertion that since fish are the source of the world's oil supply, the reservoirs of the world are being constantly added to from that source. A very simple explanation is furnished of how that happens. It is merely a process of distillation by pressure. Virtually all known varieties of fish contain oil and anybody can extract it by the pressure method. In the case of earth deposits of oil the extraction is hastened or aided by bacterial action in some instances. But the primary point is that this process is going on constantly, that it has been going on day and night year after year for millions of years.

Scores of questions naturally arise as to how anybody can know this and Dr. Macfarlane has answered them all. But first he has shown that there is no difference between fish oil and rock oil when the conditions of its preparation are alike, or nearly alike. For that proof he obtained records of an experiment made nearly sixty years ago by two scientists at Harvard University. They had been concerned over the question whether earth oil was of organic or inorganic origin. Both were familiar with the fertilizer and oil industry built up on the menhaden, or mossbunker, one of the most populous fish known on the Atlantic seaboard.

Accordingly these two men made a study of oil shale, oil bearing sands and similar strata, to obtain a general analysis of the chemical content of such materials. On the basis of that information they prepared a lime solution into which they mixed ordinary fish oil obtained from menhaden by the familiar commercial pressure method. When the mixture was made it was treated exactly as crude oil is treated for the extraction of gasoline and its other products—in other words, it was placed in a still and boiled. One after another the scientists succeeded in extracting exactly the same products as are obtained from crude oil or petroleum, until finally they had left a thick black residue resembling asphalt. The net result was proof that if petroleum was not fish oil the two products were alike in that they yielded the same by-products.

For some strange reason that Dr. Macfarlane is unable to fathom this experiment was lost and forgotten for years. About twenty years later other scientists came across the record of it, and through their action it was preserved. But again for unknown reasons very little attention has been paid to it since. The discussion as to whether petroleum came from animal or plant life has gone on and on, and most of the participants have been wholly unaware of these experiments. In recent years, as part of the investigation made by Dr. Macfarlane various repetitions of this experiment have yielded the same result.

With that fact firmly established Dr. Macfarlane set out to discover whether there have been enough fish in the history of the world to produce all the known oil deposits. There was no question that fish could have furnished the supply. It was simply one of quantity. And for that proof he turned again to the menhaden.

This fish appears in the history of American industry since the days of the earliest settlements. It is so plentiful that it has been used as fertilizer and a source of fish oil all along the North Atlantic Coast. Many of these factories are still in operation, and millions of menhaden are caught every year to enrich the farms and to provide the oil of back-country districts.

Here again Dr. Macfarlane was able to get the aid of another scientist. He found that the late Dr. Brown Goode of Washington had made a prolonged study of the menhaden and its habits. As a result of that Dr. Goode estimated that in one season of from four to six months, when the menhaden are rushing north along the coast in countless millions, their natural enemies such as the bluefish consume at least a quintillion menhaden. He got at that figure by careful studies of how many mossbunkers are eaten by a single bluefish and then estimating the number of the latter. Now an interesting point here is the fact that most scientists are inclined to believe that Dr. Goode underestimated this consumption. It may be of interest also to point out that a quintillion, expressed in figures, means a unit and eighteen ciphers, or 1,000,000,000,000,000,000 mossbunkers or menhaden.

The point of all this is that commercial oil-extracting plants get an average of one gallon of oil from 250 menhaden early in the season, when the fish are thin. Later in the season the quantity thus obtained is about doubled. On the basis of the first or lower yield, according to Dr. Macfarlane, it is only a matter of mathematics to show that this one variety of fish in a single season carry more oil than the entire world has used in the known history of petroleum wells. It might be added that the total consumption up to 1920 was estimated at close to nine billion barrels of forty two gallons each. If the menhaden can continue to exist after the annual slaughter of a quintillion of their number, it is obvious that they must be virtually countless.

The assertion that fish are responsible for all the world's oil might still be open to objection without certain additional evidence. One natural question is "how did the oil get into the earth when it is generally known that oil floats on water?" For that also Dr. Macfarlane went to other scientists. The first evidence he obtained came from his predecessor as botanist at

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How Gold Leaf Is Made

A SIGHT that never fails to draw a crowd is that of a sign painter lettering in gold. He paints the outline of the letters on the glass window or other surface and then fills in the lettering with gold leaf. This he takes from a book made of many leaves of slightly reddish colored paper. It is very curious and engrossing to see him lift the leaf out of the book by means of a long camel's hair brush, the gold film adhering easily to the hair, seemingly as light as a feather and still as dense and substantial as a sheet of metal can be.

Gold leaf is familiar to all of us. Almost every window that we pass has some lettering on it done in gold leaf. But there are probably very few who know how gold leaf is made or who realize that the art is one of the oldest in existence today. For gold leaf was made by the ancient Egyptians in essentially the same manner as it is made at the present time. It is mentioned in the Bible and in fact most ancient peoples knew it and used it.

The first question that arises in the average person's mind when he sees lettering being done in gold leaf is: Is this real gold? Gold is precious and how can one afford to use it for so utilitarian a purpose? Gold leaf actually contains the precious metal. Furthermore gold leaf is not so expensive as it appears, for a single sheet of the leaf contains so small a weight of the metal that it is really inconceivable how so fine a film can be obtained possessing such minute weight.

There is no other solid known that can be made into a film of such infinitesimal thickness as gold. Gold is the most malleable of all substances and gold leaf is the thinnest of all materials. The leaf for all its commonness and antiquity is really one of the most remarkable products made by man. It possesses a number of strange contradictory properties which mark it out from all other substances. In the first place it will last for centuries as the paintings and decorations on tombs and temples thousands of years old testify. Gold is indestructible. It is unattacked by the elements, and after centuries of exposure it still remains the original yellow metal so precious to man. On the other hand a sheet of gold leaf can be absolutely destroyed by merely rubbing it between the fingers. There is so little matter in the sheet of gold that the friction of the fingers is quite sufficient to make it disappear totally.

Gold leaf is perfectly opaque. When it is placed on a surface, it is impossible to see through it. But this same sheet of gold when held up to the light is very translucent. In fact it is easy to see through it and distinguish objects, all of course suffused in a greenish light.

Finally gold leaf is both visible and invisible. The sheet of gold when held with its surface facing the vision is perfectly visible. But when held sideways, so that edge of the sheet is being viewed it is invisible. For the sheet of gold leaf is thin far beyond the range of human vision. It requires three hundred thousand sheets of the leaf piled one right on top of the other to make the thickness of an inch. The minute weight of the gold in an average sized sheet, three and three eighths of an inch square, is seen from the fact that one ounce of gold, when made into a sheet of the same thickness would cover 146.5 square feet. Five dollars worth of gold at present prices, made into a single sheet, would cover five thousand square inches.

There is absolute proof available to substantiate the contention that the art of making gold leaf was known four thousand years ago. Then as now, the gold was made into the form of a leaf by the might of the human arm. In other words it was beaten out by hammering it with an implement. The story runs that in very early times when this art was being carried out under very crude conditions and a workman was beating a piece of gold with a smooth rock he inadvertently covered the metal with his goatskin apron and beat the metal through the same. To his great surprise he found that the gold beat out into a much thinner and finer sheet. This marked the real start of the goldbeater's art.

Today the beating is carried out with a hammer, a cast iron hammer fastened to a wooden handle being used. The art consists in being able to distribute the blows over the surface of the beaten gold so that the extremely fine film is not torn. That there is a real technical skill involved is easily seen. It is hard to imagine how the blow of such a heavy hammer can be applied to the pack of gold leaf films, interleaved with goldbeater's skin without smashing the whole mass of leaf into a fine powder. And yet a skilled beater will make but few holes in the gold leaf film.

The first stage in the process is to take 999-plus fine gold and mix it with a little copper or silver and make an alloy by melting in a crucible. The gold is then poured out into an iron mold one inch wide by six inches long by one eighth of an inch thick. The slab of gold obtained in this way 23 karats fine is squeezed between jeweler's rollers until a comparatively thin ribbon, one thousandth of an inch in thickness is obtained. The ribbon is then cut into inch squares, each containing six grains of gold.

These squares are interleaved with pieces of parchment paper. Two hundred sheets of gold in the pack are hammered with an eighteen pound hammer and the gold gradually spreads until the square is 3.75 inches on each side. This particular part of the process is very laborious for the hammer is rather heavy and its constant use tires the arm. It is the only part of the gold beating process in which mechanical beating machines have been able to replace hand labor.

Then each sheet of the beaten gold film is divided into four equal squares giving 800 sheets from the original inch square gold ribbon. A pack is than made of 800 sheets, each sheet being separated from the next by a sheet of goldbeater's skin. **This is a peculiar substance which is obtained by skinning the large intestine of the ox. The skin has a rough and smooth side and is very thin. Two of the skins are placed together, rough sides facing each other, and are stretched on a frame. The skins are made to join to give a single goldbeater's skin which is varnished with a special varnish, giving the finished product a golden yellow color. The skins are then cut into proper size and are ready for use. The toughness of the goldbeater's skin is remarkable, it stands up extraordinarily well under the pounding with the heavy hammers.**

The pack of 800 sheets is now beaten with a twelve-pound hammer until the sheets of gold are 4.25 inches square. The beating operation lasts two hours and the beater pounds his hammer against the pack, distributing his blows to cover the entire surface evenly, starting at the center of the pack and working progressively outward while holding the same firmly between his thumb and fingers on the anvil.

The beaten films are again divided into four equal squares, giving a total of 3200 films of gold from the

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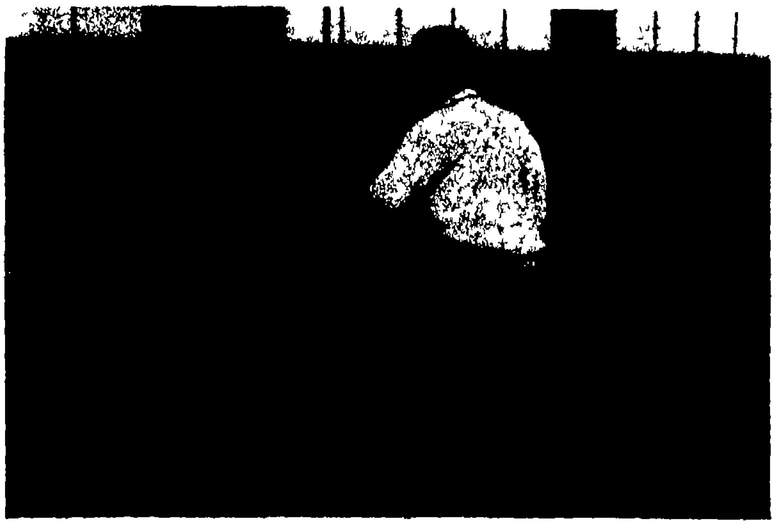


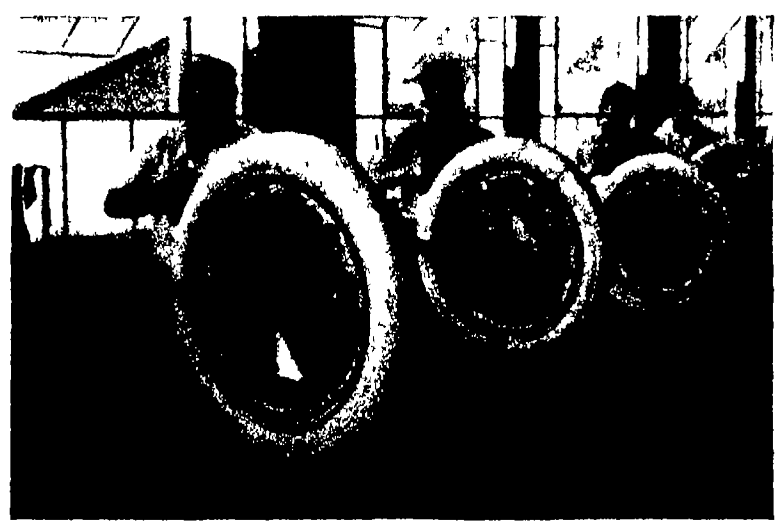
Of the three varieties of raw materials, those known as smoked sheet and pale crepe are comparatively clean though they must be washed and dried before use The third variety fine Para, which is less used today than formerly has to have sticks stones and other foreign matter removed very carefully as here shown before it is used

Mixing mill into which the crude rubber and the chemicals are thrown to be thoroughly crushed together between the rollers Batteries of as many as thirty of these mills are used and in the largest factories the rollers may be twice as long as these here shown When the mixing is complete the mass resembles putty or soft dough

One of the big calender machines in which the fabric is impregnated with rubber gum for the purpose of making the sheets stick together when built up into a tire As suggested by the caption for the second picture above, the latest practice is inclined to favor a considerably wider fabric The roll of cloth in the foreground is an apron that is wound up with the coated roll to keep its layers from sticking together

The hot-press tubing machine one of two procedures that are used for forming the treads The latter which are much thicker in the center than at the edges are in this machine pressed through a die the exact shape of the cross-section of the desired tread and cut off at appropriate lengths In the other and more recently developed process the treads are formed in a calendering machine of specially shaped rollers

After the vulcanised tire is taken from the case, the steel core is pulled out of the tire Here the *elbow-grease method illustrated is being largely supplanted by an automatic machine*



Finishers at work smoothing down the joints of the outer tread which is of pure rubber gum As the picture indicates no satisfactory machine for doing this has been devised

While the cord tire is radically different in its structure from its fabric predecessor this difference is not such that an entirely different outfit of machinery is necessary, from start to finish, in its production. Many of the processes in the preparation of both types of shoe are similar and accordingly many of the improvements in machine design which really belong to the cord tire have reacted upon the fabric tire and have gone into use in its production The effort in the above pictures has been to tell how the typical fabric tire was made in the hey-day of its career, rather than how fabric tires are today made with as much of the cord tire technique as is applicable. In an early issue we shall present a similar series of photographs for the cord tire, which will show how these improved and more expensive shoes are made The two stories together will be an epitome of ten years of tire history

MACHINES AND METHODS USED IN THE MANUFACTURE OF THE FABRIC TIRE

The Next Great Flood—Where?

How the Study of Probabilities Aids Our Engineers in Fighting an Age-Old Menace

By Harry A. Mount

ONCE in every few years this nation is appalled at the spectacle of a great flood disaster. Johnstown, Galveston, Dayton, Pueblo—these names bring recollections of great floods of the past. Those of us who are lucky enough to escape such misfortune sympathize with the victims, perhaps give something for their relief, congratulate ourselves that we do not live in such a dangerous spot on the map—and forget it.

Few consider that there are hundreds of American communities exposed to the probability of flood in a greater degree than was Pueblo or Dayton. In a very few instances some protective measures have been taken. In many others scientific investigation has fully established the existence and the extent of the threat but the community, in characteristic American fashion, prefers to take a chance rather than spend money for flood prevention. Still other communities are exposed to the danger of flood and do not even know it.

Disastrous floods are no new phenomenon. Records of great floods dot the pages of history since its beginning. Geologists have been able to determine that the same streams which now are menacing American towns and cities have had great floods for hundreds of years, even thousands, and that the floods which now occur are no greater in volume than those which have been. The difference is that we have built homes, factories, railroads and highways in the natural path of flood waters and now we must either hold back the stream at times, dike ourselves in, or take the consequences.

Floods represent a very complex study in probabilities. The size and intensity of floods and the frequency of their occurrence are governed by a number of variable conditions. Mr. Weston E. Fuller, one of the foremost engineering authorities on the subject, divides the causes into two classes in arriving at a method for determining the probability of floods. In the first class he includes the prevailing condition of rainfall, the size, shape and slope of the catchment area, the character of the soil and vegetation of the catchment area, the physical characteristics of the stream channel, the storage capacity of reservoirs and many other physical characteristics of the catchment area and the stream itself. In the second class falls such conditions as the rate of rainfall, snow conditions, temperature conditions, the quantity of water stored in reservoirs, lakes and the ground at the time a flood occurs, the velocity and direction of the storm, the formation of ice dams or other temporary obstructions in the river and many other elements which cause one flood to differ from another in the same stream.

No two floods are ever exactly alike because of the interaction of the great number of variable conditions. Thus, two storms of the same intensity passing over the same river basin may produce very different floods. One storm may come at a time when the ground is dry and the water is low in lakes and reservoirs and may produce only a moderate flood. The second, coming at a time when the ground, lakes and reservoirs are filled, may produce a large flood; or if the second flood occurs in conjunction with a high temperature when there is a large quantity of snow on the ground, a very heavy and disastrous flood may occur.

The most common protection against floods are levees to hold the swollen stream within its banks. The builders of these levees have generally overlooked the fact that embankments defeat their own end in that the higher they are built the higher the floods will go until a point is reached where the levees are high enough and strong enough to hold the maximum possible flood. Flood waters which formerly spread over large areas are confined to a narrow channel and must for a flood of the same volume rise to a higher level. This has happened along the Ohio and Mississippi rivers where there are very extensive levee systems. While it is true that levees prevent a great deal of damage from small floods, when the water does break through the damage is likely to be much greater than if no levees existed. In any event the city which builds levees high enough and strong enough to keep out all floods, enjoys its protection at the expense of other communities which have no adequate protection.

Nevertheless there seems to be no other economical method of protecting against floods on very large streams. The only alternative is to prevent the flood in the first place by building reservoirs of sufficient size to hold back flood waters in time of danger. In the case of the Mississippi this would mean reservoirs comparable in size to the Great Lakes, and, of course, that is out of the question.

The best natural protection against floods is natural reservoirs. Throughout New England, and especially in Maine, where the country is dotted with lakes, disastrous floods are much less likely than in the Middle West where there are few natural lakes. The St. Lawrence, which originates in the Great Lakes, is an example of a perfectly controlled river.

When the great variety of conditions that may effect a flood are considered, it will be seen that the number of combinations of circumstances which may occur are infinite. When very large floods occur it is always because of the coincidence of abnormally heavy rainfall with a number of other conditions tending to floods.

What happens to the community which has given little or no thought to the question of flood prevention

One important deduction Mr. Fuller has made is that if we can determine the average yearly maximum flood on any stream we may reasonably expect that within a period of five years there will occur a flood 1.58 times as great; within 10 years a flood 1.80 times as great, in 25 years 2.12 times as great, in 50 years 2.36 times as great, in 100 years 2.60 times as great, in 500 years 3.16 times as great, and in 1000 years 3.40 times as great.

This does not mean that floods of these magnitudes are bound to occur in these periods but these are the betting chances that they will occur. Several of the floods which have occurred in this country in the last 20 years have been larger than should have occurred, according to this table, in 1000 years.

The value of the calculation is that it enables engineers to tell with a fair degree of accuracy just how much insurance against flood a community is buying on a definite expenditure.

The most extensive flood protection project in this country is the Mississippi river levees, but these may be reckoned only as temporary protection because they are inadequate in large floods. The most ambitious flood prevention project, as differentiated from protection, is the Dayton project, which has cost some $50,000,000. Mr. Arthur E. Morgan, the engineer in charge, estimates that the protection afforded Dayton is permanent and that there is no chance whatever that ever again a disastrous flood will occur at Dayton.

It is Mr. Morgan's estimate that instead of the flood of 8.9 times the average yearly maximum that might have been expected at Dayton in 1000 years, the flood of 1913 on certain tributaries of the Miami actually was nine or ten times as great. Mr. Morgan concludes from wide experience that the whole interior portion of the United States is subject to rare local floods of very great intensity, three or four times as great as Mr. Fuller's table indicates, small streams being more erratic than large ones.

As Dayton and the Mississippi levees represent the largest protection projects undertaken in this country, the city of Pittsburgh is probably the most conspicuous bad example. Pittsburgh lies at the junction of the Allegheny and Monongahela rivers and the business section of the city is on the delta between them. The low land along the rivers for miles is bordered by the great steel mills and industrial establishments.

The city has been very fortunate so far in the matter of floods, although the greater part of this low lying area has several times been inundated within the past 15 years, with a property loss in that time of about $15,000,000. A very thorough survey of the situation completed in 1912 showed that while there was authentic records of 53 floods in Pittsburgh ranging from 22 to 37.5 foot stages, it was not improbable that some day Pittsburgh may have a 40-foot flood which would cause a disaster equal to anything this country ever has seen. In the past the city has always been lucky that only one at a time of the streams which meet there has been flooded to an extraordinary degree. When it happens that both have great floods at the same time Pittsburgh will be a sorry city.

A system of dams above the city similar to the scheme carried out at Dayton was proposed and the cost at that time would have been about $20,000,000. It was shown that the assessed value of the land affected was $100,000,000 and that this property was nearly $50,000,000 lower in value than if it was protected from floods, but the project got no further than discussion. According to Mr. Fuller's table the floods which Pittsburgh has had within the past 50 years have been no greater than might normally be expected in a period of 15 years.

It is probable that large cities such as Pittsburgh will eventually learn from bitter experience that flood prevention is cheaper than floods. When a number of the tributaries to the large streams are controlled the danger of bad floods on the large streams will be reduced and thus at some distant day we may expect the number of disastrous floods to be reduced in this way.

But the threat of flood to hundreds of small communities which now exists probably will continue to exist and whenever the fatal combination of circumstances occurs we shall have another flood horror.

Flowers That Dislike Music

IT has been recently observed that several kinds of flowers are very much affected by music. Where there is a constant volume of sound for some hours during the day certain sensitive blossoms develop a leaning tendency away from the direction from which the music comes. It has been shown that the cyclamen and the carnation are especially susceptible to the influence of music. Some of these which had been used as floral decorations close to a stand where a jazz band was frequently playing dance music were affected to an astonishing degree. After a few hours it was discovered that all the blossoms had deliberately turned their backs on the source of the music. Even when they were placed facing the stand it was not long before each bloom reversed its position. Flowering specimens of the white Easter lily were also affected in the same way. Although little is known at present about this curious phenomenon there is no doubt that blossoms of several kinds are affected by the vibrations which are set going when music is performed.

Does Steel Melt from the Inside?

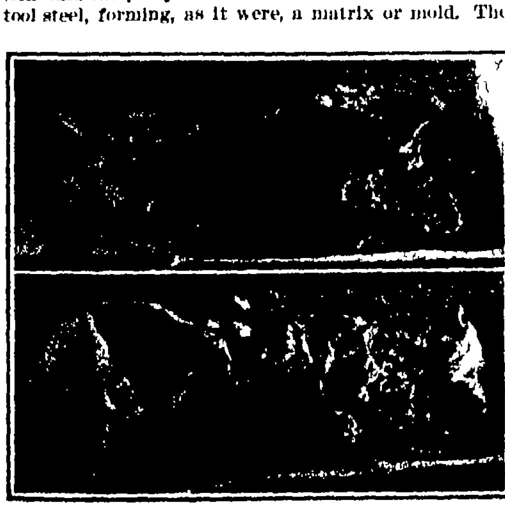
MR. G. P. BLACKISTON, of Canton, Ohio, sends us the accompanying photograph of some metal which he was melting, some twenty years ago, in a crucible steel plant. In the manufacture of crucible steel he reminds us, the mixture to be melted consists of definite and carefully weighed amounts of certain grades of wrought iron, blister bar, alloys, and scrap which are placed in pots. These pots when filled and covered are placed in a furnace which contains a number of holes—six pots, three deep and two abreast being placed in each hole. The holes are then covered and the pots are subjected to a heat of 3000 degrees Fahrenheit for a period of from two to three hours. After the mixture is melted, the pots are allowed to stand in the furnace until all the gas has boiled out. The molten steel is then ready to be cast.

The mixture used at the time that the incident occurred included numerous pieces of octagon bar steel, such as is used for chisels and rectangular bar steel, such as is used for lathe and planer tools. After the pots had been packed placed in the furnace and the melting was well under way one of the pots broke and was immediately removed from the furnace and set to one side. When the pot had cooled Mr. Blackiston observed that chunks of metal were present which seemed to have the original shape they possessed at the time they were inserted in the pot. By tapping them with a hammer a hollow sound was noticeable and upon further investigation the pieces were indeed found to be hollow. They were carefully removed and are shown in the photograph. It will be observed that the pieces removed from the pot are two hollow shells that have retained their original contour, except that in the process of melting the molten metal in the inside found a weak spot in the outer shell and passed out through the opening shown. Mr. Blackiston asks whether this does not suggest that these pieces of steel melted from the inside to the surface and not from the surface to the interior as is generally supposed.

Now we are of the opinion that the explanation of the curious appearance of this specimen is to be found in the fact that metal carrying a high percentage of carbon has a lower melting point than a low-carbon metal such as wrought iron and that the tool steel melted before the other contents. Before a charge of metal in a furnace passes into the fluid condition it assumes a pasty semifluid condition and furnace men tell us that sometimes in an open hearth furnace when the charge is slow in melting or because of a temporary drop in temperature begins to thicken up, it can be quickly brought to the fluid condition by introducing a mass of cast iron which, because of its high carbon content, serves to hasten the melting.

Probably, in the case before us the miscellaneous material in the pot had reached the half melted condition and the pasty material formed around the hexagon tool steel, forming, as it were, a matrix or mold. Then as the temperature rose the steel melted and ran out of the matrix of more refractory lower-carbon material leaving a hollow space corresponding to the original shape of the tool steel. At this point, before the whole mass was melted, the pot broke and was withdrawn. If this was the sequence of events it will explain the curious appearance of the contents.

A metallurgical engineer to whom we showed this photograph is of the opinion that the octagonal shell upon analysis would probably be found to be neither tool steel nor soft steel but something of a conglomerate of the two.



Hollow pieces of tool steel scrap, found in broken crucible pot after partial fusion, which apparently proceeded from the inside, out

Storing Gasoline Under Pressure

OWING to its high volatility gasoline must be stored under pressure if it is to be kept from season to season without great loss by evaporation. But the ordinary flat bottomed cylindrical storage tank has a great handicap. It cannot be kept gas-tight. It soon becomes distorted under pressures of fifteen or twenty pounds per square inch the bottom sagging down in the center. At the same time the perimeter rises. Leaks sufficiently large to keep a constant stream of gasoline vapor passing off from the tank develop as a result of the distortion of the tank and within a few months the stored gasoline has lost its most valuable properties.

To obviate these troubles a Chicago manufacturer has invented and built a perfectly spherical storage tank of steel which is able to withstand the pressure due to the weight of the liquid as well as the superadded storage pressure without suffering any distortion. This type of tank is known as the "Hortonsphere" and those now under construction are about fifty feet in diameter and have a capacity of 10,000 barrels.

In order to protect the sphere against too high pressures due to the absorption of solar heat with consequent rapid vaporization of the contents, the tank is covered with a thorough surface insulation while to this is added a coat of white paint intended to reflect a maximum of sunlight away from the tank.

The tank weighs about 110 tons but its full load of gasoline adds another 1[illegible]0 tons. Ten heavy posts carry this weight to the foundation piers. These posts are made of fifteen-inch channel sections and are riveted at their upper ends to the center ring of the tank. The tank itself is not welded but is calked on the outside.

It is a mathematical fact that stresses in a sphere for a given pressure are only one-half what they are in a cylinder of the same diameter. In a cylindrical steam boiler the metal in the sides is subjected to twice the tension in one direction that it is in another. Both ends of the boiler are pulling equally hard in an opposite direction doubling the stress in its longer direction. The same fault exists in the cylindrical pressure storage tank for gasoline, but the spherical tank gets around this drawback.

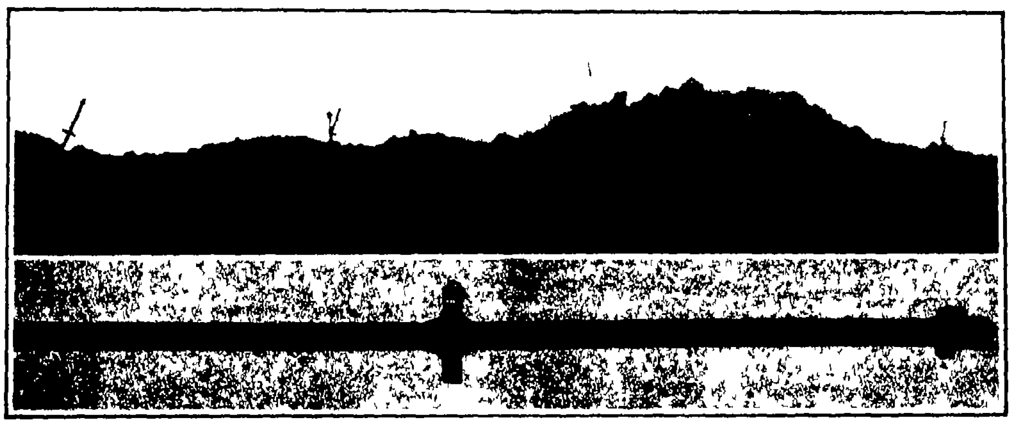
Round tanks for storing gasoline under pressure without loss through leakage

The Spontaneous Combustion of Stored Coal

BECAUSE of the danger of its loss by spontaneous combustion the managements of large industries often hesitate to keep enough coal on hand to take advantage of lower prices during certain periods of the year to insure against interruptions of supply which entail costly shutdowns and to insure against excessive prices during fuel shortages. All coal is subject to the phenomena of spontaneous combustion and it is due to local conditions prevailing in certain portions of the pile where a balance is struck between insufficient air and excess of air. It is therefore a local condition occurring in a small spot and if allowed to progress, spreads through the pile. Dangerous heating generally occurs between two and ten feet from the surface. All coal heats some but if the heating temperature does not exceed 125 degrees Fahrenheit no danger exists. But 150 degrees is the danger point.

It is stated by a Jersey City, N. J. manufacturer of a device called a protectometer that odor and smoke are not safe means of detection for when the coal reaches this stage it is well along in the process of combustion. If the small part of the pile where the combustion originated can be located the simplest solution is the shovel. How then to locate the hot point? By inserting in the pile on centers of 15 or 20 feet a number of these "sentinels." These consist of pointed tubes each containing a link of such a composition that it is fusible at 150 degrees. When the link melts out a signal head is released, which after it springs up is visible for several hundred feet. A somewhat similar device is used for sounding around critical spots and watching them. Instead of the fusible link it has three thermostatic elements at three points in its length and these connect with dial thermometers mounted on the head of the protectometer.

Each sentinel can guard from 100 to 300 tons of coal and with a group of them inserted in a large storage area any member of the working force can glance them over at reasonable intervals in a few seconds. The general use of such devices as this would tend to enable the railroads to transport coal in good weather when cars are available and to give steady employment to miners rather than the present seasonal employment. This should lower the price of coal and remove the ever present fear of having to close down large industries because of temporary coal shortage.



The "sentinel" that gives a visible indication when the temperature of the coal pile rises beyond the safety point, and a big coal dump protected by these devices against the ravages of spontaneous combustion

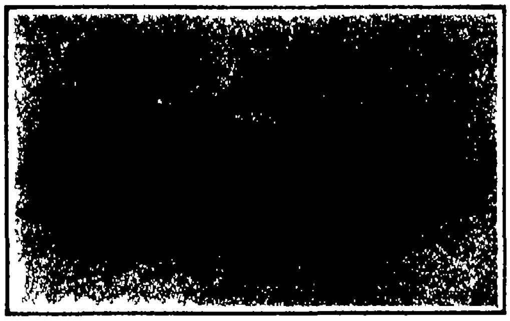
Hereditary Immunity to Disease

IN a recent paper read before the American Philosophical Society Professor M. F. Guyer of the University of Wisconsin stated that by inoculating successive generations of rabbits with the germs of typhoid fever he was able to develop in their blood an antibody which is transmitted from mother to offspring and renders them more immune to the disease. Rabbits of the fourth or fifth generation so treated may be made capable of overcoming an injection of thirty to forty times as many typhoid bacilli as the original rabbits could stand. Whether such acquired immunity is also transmissible through the paternal side has not yet been determined but as Professor Guyer says: "It is of interest to learn that young may not only acquire immunity reactions from their mothers, but may retain them sufficiently to transmit them in a measurable degree without further immunization to their offspring. Even if this is nothing more than maternal transmission it may be of practical importance, since a large percentage of a population might in time through such transmission come to exhibit some degree of immunity to a widely prevalent disease. If the results of our future experiments bear out our present data it becomes evident that when succeeding generations of rabbits are immunized to typhoid bacilli some modification is made in the immunity mechanism whereby individuals of later generations are capable of developing higher resistance against these germs."

Checkmating the Moth

New Investigations of the Life Cycle of this Insect and the Possibility of Preventing its Ravages

By Dr Albert Neuburger



Full grown female moth, magnified ten diameters

ALTHOUGH the moth belongs to the domestic animals (though not to those we wish for) and does much harm to our wardrobe and our furniture all the year round zoological research had not succeeded as yet in finding out the secret of its life and its propagation The reason of this fact is, that certain details of the moth life-cycle are very difficult if not impossible to be observed though great numbers of moths fly about everywhere continually In consequence this mischief maker could not be fought successfully Different strongly smelling chemicals were used (camphor naphthaline etc) because it was expected that their smell would keep off the moths—whereas it was not even certain that these animals possess the faculty of smelling Moths have been seen crawling about on bales of naphthaline—on the other side good experience was had with these and similar chemicals

This contradiction may be explained by the fact that there are different species of moths which also differ in their customs of life Thus there exist besides the clothes-moth which only resides in clothes and furniture a paper moth which destroys books and wall papers, a leather moth eating leather a fur moth etc etc All these different species belong to the same family of butterflies to the Tineidae But they are found not only in the clothes of mankind that is, in wool leather paper and furs but also in grains on some trees and single species occur on apples and even in bee-hives where they sometimes happen to be in such multitudes that the whole hive is destroyed and the bees swarm out to found a new home elsewhere

As mentioned above all the details concerning the life of these animals were not very well known until now But according to modern views the combat against an animal or a plant doing harm can only be led successfully when its customs of life are known to us in full detail Nowadays the combat is led on a purely physiological basis, whether it concerns bacteria parasites or whatever it may be All single phases of its life are investigated after which every possible means are applied to make its survival difficult or impossible

Full grown moth caterpillars, likewise magnified ten times

Concerning the moths the zoologist Dr Titschak at Leverkusen has made detailed researches which have had remarkable results To begin with he has stated that it is of relatively little avail to catch moths that fly about in the room and kill them For these moths are always masculine The feminine moth whose destruction is much more important does not fly often because the back part of its body is too heavy for flying This back part is considerably larger than the one of the masculine moth and is filled with eggs to the greater part so as to be like a heavy sack For this reason the female sits generally quietly in a hidden corner It moves little and generally crawls about slowly If it ever flies it does so much slower than the male and with a slower flapping of the wings For this reason there will be rarely an opportunity to see a female moth flying or even to find one at all the more so, as they are rather scarce. To about ninety or a hundred males there is perhaps only one single female moth That is why the catching of the males is of so little value, as there are always enough which remain living and know how to find the rare female which men will generally not be able to see

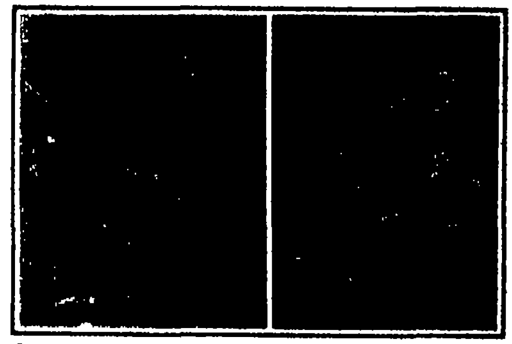
To find the ova and the greedy caterpillars which crawl out of the ova is as difficult as to find the females Both are less than a millimeter long The caterpillar grows though but when it is big enough to be seen by sight alone it is generally too late The female does not lay its ova directly on the material the clothes, the furniture etc , etc , which are spoiled so badly later on by the caterpillars Quite on the contrary, it lays them in some corner in small cracks of the floor and such like places where they are neither looked for nor to be seen at all From them the wee caterpillars crawl out When laying the ova the female does not provide for food somewhere near them Thus the caterpillars begin to wander and to look for food The females have died after having laid their ova and as their bodies are generally to be found near the place where they laid their ova they are generally eaten up by their own descendants Then these wander until they find at last woollen materials or furs, or if they are cork moths stoppers of bottles Here they have what they looked for, that is food

Now they begin to feed with a greediness that is astonishing The holes in the materials grow bigger and bigger and with them the caterpillars grow and reach at last the length of a centimeter But it may be a year before they reach this size As they take their food only from these materials and eat nothing but these the size of the holes in these materials corresponds with the size of caterpillars in every respect

When the caterpillar is observed it is often too late for it has then already done great harm It is singular that it knows well how to differentiate the materials in eating for in mixed woollen materials which consist of wool and cotton it eats the wool alone and leaves the cotton untouched

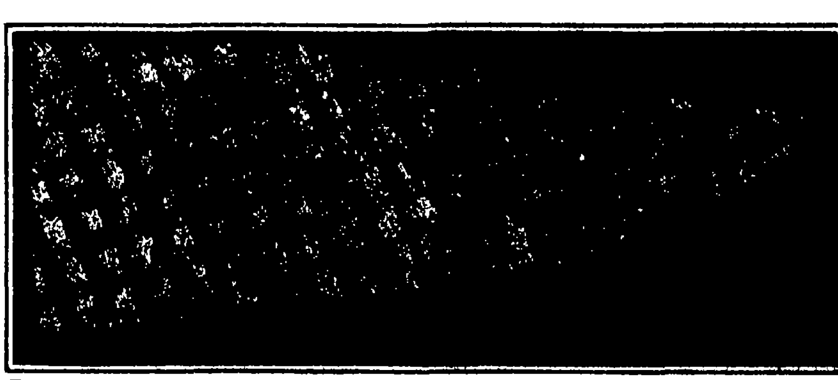
When the caterpillar has lived for some time and has reached a certain size it begins to pupate To form the cocoon it uses its own excrements mixed with wool, horse hair and such like material The cocoon will stick fast to clothes covers carpets, etc to which the caterpillar has fastened it From this cocoon the butterfly comes forth and the cycle of life as described here begins anew for another generation

The researches which Dr Titschak continued for years which have just been finished and the results of which we have reproduced pictorially, show what enormous difficulties arise when we strive to destroy the moths Frequent beating, which is recommended, is certainly useful, but will not remove the caterpillars from the materials to which they are firmly attached by their trophi nor will it remove the well-fixed cocoons If the garments are beaten much, of course the number of caterpillars will be greatly diminished by and by But a certainty that they all have disappeared is not given Even when looked over ever so carefully, young and small caterpillars will be overlooked When the pieces are locked into a moth proof case after they have been beaten, there is the danger that not all the caterpillars have been removed by beating and that those that remain continue their work of damage within the case But of course, a well closed box is a good protection against the immigration of new moths Dr Meckbach calculates the value of the wool eaten by the moths in Germany as many millions of gold marks yearly But the whole damage is, of course a much larger one than the value of the wool as in many cases clothes furniture etc , are damaged which lose in value by the holes the moths have eaten The effect of many strongly smelling chemicals appears to be doubtful as mentioned above and there remains the open question how to prevent the damage by moths.



Destruction wrought by moth caterpillars, and ten-fold magnification of the eggs from which they hatch

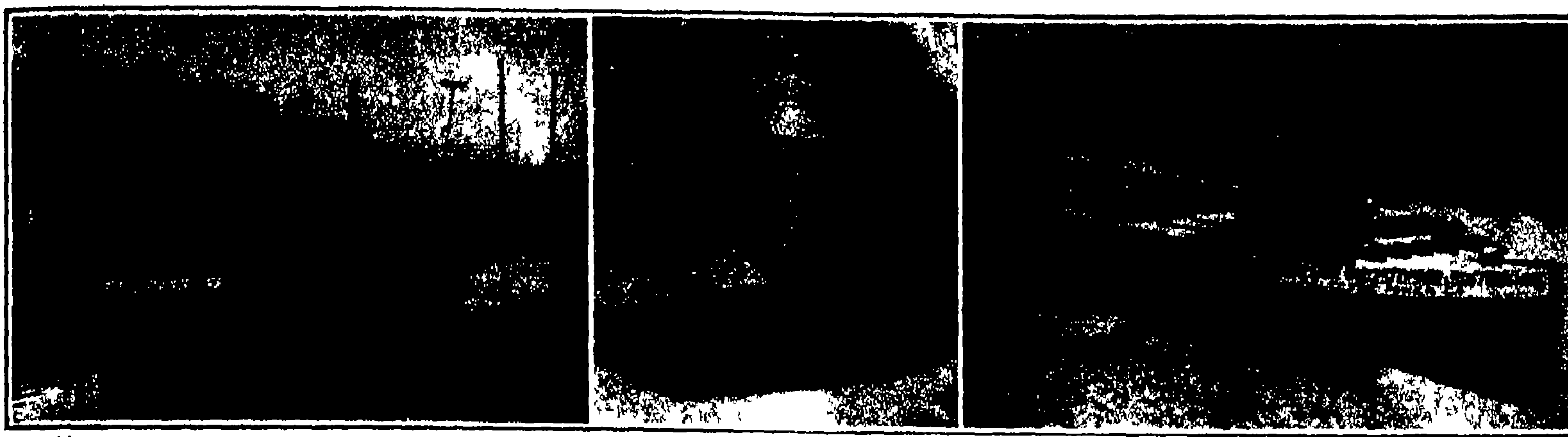
On the basis of his physiological researches concerning the customs and the generative faculty of the moths Dr Titschak asserts that it is best to keep food from the caterpillars so that they perish by hunger The simplest method of doing this is to combine the wool with a substance that makes it inedible for the caterpillars. It is very hard to find such a substance which of course, must be without any smell not to make it disagreeable to wear the clothes or to remain in the house and which may not influence either the colors or the qualities of the wool It must be possible also to treat water proof material with it After Dr Titschak has tried more than 2000 chemicals, he has succeeded in finding one that would fill the bill Threads, textures, felts impregnated therewith show no trace of this treatment after drying They look the same as before they manifest no objectionable order, they are soft and pliable and have not changed in any way But the caterpillars put upon them do not touch the food any more and quickly perish with hunger



Textile fabric of half wool and half cotton, showing the precision with which the moth caterpillar selects its food

Slag Concrete Roads

SLAG as concrete aggregate has been used in concrete roads for something like nine years, and there are about 225 miles of such roads now in use in various parts of the United States. In some places this is the most economical and most easily obtained aggregate, but many engineers and contractors lack confidence in its wearing qualities. Extended observation of slag-concrete roads in construction and operation, recently made, indicate that while this material presents peculiarities as to original manipulation and as to wear, roads built with it are in substantially as good condition as those of comparable age using natural aggregate.



Left: The 25-ton barge, showing overhead trolley wires and trolley from which current is obtained for driving the jet-pump *Center* The controller for starting and stopping the motor *Right* The power unit, consisting of an 18-horsepower vertical electric motor direct connected to a centrifugal pump It revolves in a well thus enabling the barge to be steered

The English canal-barge that is propelled by the water jet system

Water-Jet Propulsion

ONE of the favorite subjects for the efforts of would be inventors is the propulsion of ships by means of the reaction from jets of water directed astern This system has the advantage that it works, and the disadvantage that it is decidedly inefficient An installation of the sort has, however been made in England and the peculiar circumstances under which it is used fully justify the loss of efficiency

The Midlands canals are very shallow and have become somewhat obstructed with underwater growth of weeds. The customary horse towage has become too expensive, while the shallow canals make use of the screw propeller impossible A Norfolk manufacturer of propellers was therefore given the opportunity to design a special propelling unit having a water jet made by an electrically driven centrifugal pump

Into a cylindrical, open well built into the bottom of the barge and reaching through to the deck is telescoped the power unit which consists of an 18-horsepower electric motor direct connected to a 10-inch centrifugal pump, both on a vertical shaft This unit is carried on ball bearings in such a manner that it may be rotated by means of a tiller In this manner the barge may be steered without a rudder, simply by turning the water jet In addition it may be stopped or reversed by swinging the tiller through an arc of 180 degrees

Owing to the fact that grass would quickly plug the intake opening of the pump, the latter is provided with a number of guides while immediately below these guides is mounted a bar having a sharp cutting edge When weeds collect on the intake a quick movement of the tiller or simply the ordinary steering movements suffices to cut them between the guides and the bar

The supply of current for the 18-horsepower motor is taken from two trolley wires suspended over the canal With the motor consuming 12 horsepower a speed of 3½ miles per hour was given to a 70-by 7 foot canal barge having a nominal load tonnage of 25 tons and the cost of power works out at one-fifth of a cent per ton mile The cost of the overhead trolley wires was about £600 per mile Allowing for capital cost the working expenses of the electrically propelled barge are about half those of the horses whose place the installation takes.

The weight of the complete installation is 2400 pounds and it can be transferred in a few minutes to any other barge which is equipped with the necessary well.

Old Egyptian Water-Clocks

SEVERAL ancient time-observations, such as the statement of the equality of day and night at the equinoxes, make it clear that some form of clock was employed. It is therefore interesting to note that casts of two Egyptian water-clocks have lately been presented by the Egyptian Government to the Science Museum South Kensington One from Karnak dates from the reign of Amenhotep III (B C 1415-1380) the other from Edfu is of the Ptolemaic Epoch In the former time is measured by the uniform escape of the water in the latter by its uniform admission In each case there are twelve different scales corresponding to the length of the night or day in different months Each of these scales is divided into 12 equal parts showing that an hour was at first of variable length being one twelfth of the length of the day or night at the particular time of year

Claudius Ptolemy collected the observed times of the phases of a number of lunar eclipses, these were used by several investigators including Newcomb Cowell, and Fotheringham in studies of the moon's secular acceleration As the times were presumably observed with some such instruments as those now exhibited their study with an estimate of their accuracy, is of some astronomical importance

The locomotive of the monorail line, showing the double flanged wheels and the low hung center of gravity as the rail is straddled

Conquering Excessive Grades and Curves with a Monorail Line

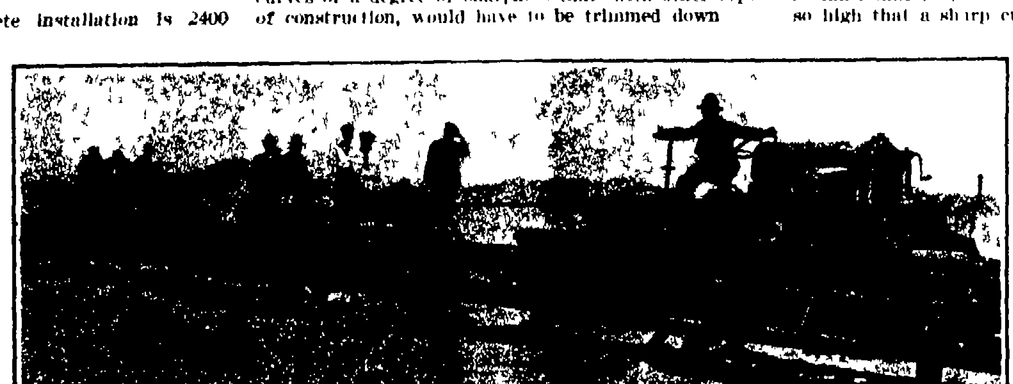
IN building in to tap a magnesium sulfate deposit situated far back in the mountains of southern California it was decided that a monorail railroad would be the most practical type of construction In preparing for such a line very little grading would be required and furthermore there could be incorporated curves of a degree of sharpness that with other types of construction, would have to be trimmed down

At the present time about 19 miles out of the 28 being constructed are under operation This road is being operated with Fordsons carrying a load of approximately three tons, and five tons on a trailer The company has two of these and has just installed a Buda engine on No 3 which has worked over the road a few times It is a pleasure to watch this engine make 10 per cent grades and 50-degree curves she has loaded herself with at least four tons carrying a five-ton trailer and pushing a lumber car with at least five tons on it making a total of something over 15 tons to a trip This engine makes these grades and curves in second speed Just how large a load the engine will pull has not been determined but the company feels sure that the tractor would come over the hills with 16 tons of material, besides its own weight

During the month of October the foreman with 30 men completed four miles of road that was very rough and a great part of these men were on the shovels owing to the rocky washes that were encountered Standard ties are used placed on eight foot centers Each bent consists of a single plumb post placed in the center of the tie and braced on either side On the plumb posts is a stringer supporting in turn the single 40 pound rail The timber side rails serve as guide rails. Their faces make contact with the rollers on either side These rollers serve to maintain the equilibrium The engine and cars are designed much like a pack saddle they are suspended on two wheels from the single rail with heavy overhang as illustrated The tractors are chain driven from both the front and back wheels

It is felt that this type of road has several advantages for desert hauling where grades and curves hamper a two-rail line The safety over cloudburst territory is well taken care of compared to a surface line This structure stands 34 inches to the top of the rail above the average level of the ground The ore cars clear the ground on the sides about six inches There have been several wonderful demonstrations of safety on this line On these very severe grades on several occasions the train crew has lost control of their train and the trains have started down over these grades and curves at a high rate of speed loaded In setting the rail brakes the crew would then set them so hard that they would raise the double flange wheel so high that a sharp curve would throw not only the wheel but also the brakes off the rail In this event the wheels would leave the track, but never have the cars or trailers left the structure or done any damage outside of breaking a few guard rails However, the company now has safety devices in use which prevent the cars from being thrown off the rails at any rate of speed no matter how violently the rail brakes may be applied

The cost of building a mile of this monorail road varies from $5000 to $7000, according to the territory passed through



Complete monorail train ready for action. Even when the wheels rise clear of the rail, the timber side-rails and the deep straddle keep the train on the right-of way

Wrapping the home in fire proof balsam-wool gives the owner a 30 per cent saving in fuel and makes the house healthier and more comfortable

Man-Made Lumber

Revising the Structural Arrangements of Saw-Mill Waste to Make Possible Its Utilization

By Howard F Weiss

CELLULOSE is the structural material out of which the frame-work (trunk limb and twigs) of all trees is built Its chemical composition is fairly uniform, but as it occurs in trees it has associated or combined with it a variety of other compounds such as lignin pectin, suberin etc all of which impart to the natural or ligno-cellulose a variance in color and chemical properties

The physical form in which cellulose is built up by the growing trees varies even more than its chemical In certain trees it is developed into long hollow tube-like cells or into short hair like fibers or in dense thick walled and more or less circular "stone cells,' or at times into delicate brick shaped, pith ray cells It is these variations in the chemical and physical structure of the cellulose formations that enable the identification of the various woods with scientific accuracy and which also determine the commercial uses to which the various woods are put

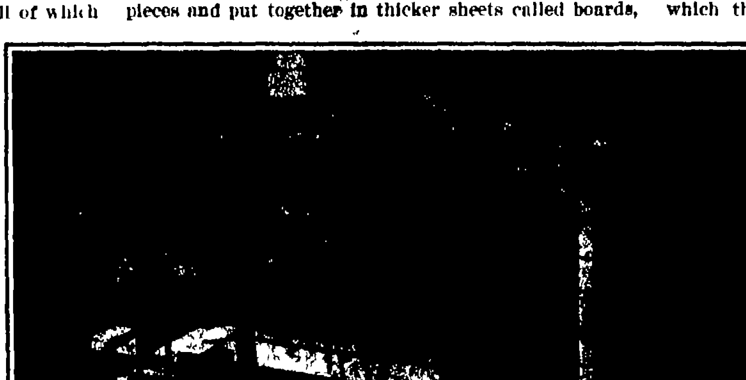
Two great primary industries have been developed in this country that are dependent entirely or almost so upon the cellulose structure of trees for their existence, and from these two primary industries a host of others in turn derive their existence The combined result is that millions of dollars of capital are invested in, and hundreds of thousands of American workmen derive their living from changing the cellulose structure of wood and converting it into forms suitable for modern industrial requirements These two great industries are the paper industry and the lumber industry both of them the primary feeders for an enormous tonnage of commodities intimately identified with our daily existence

Although both of these industries use the same raw material namely living trees they differ almost at the very start in their method of operation This difference occurs even in the logging operations and it is seldom that logs for lumber and paper mills are gathered at the same time, although in late years there has been a tendency to consolidate these operations to some degree

The main difference between the sawmill and the paper mill process is that the sawmill changes the cellulose structure only in mass while the paper mill is not satisfied until it alters the form of the minute and individual tree fibers and often their chemical structure as well Thus one industry deals with the tree in large units while the other industry dissects the tree to individual and minute particles Because of this the paper industry is able to use trees with a much wider variance in size and shape than the saw mill industry and it furthermore can change the chemical and physical structure of the wood fibers so that its finished products, even from a great number of different trees, are all of uniform grade and quality This is not so true of the sawmill the finished products of which reflect directly the inherent characteristics and properties of the individual trees from which they came

In the conversion of round trees into square-edged lumber much wastage or offal is bound to occur This takes the form of slabs, edgings, sawdust shavings, etc Some of this offal is used for fuel, but much of it finds its way to the burner and is destroyed This is the practice at most sawmills now operating in the United States and as a result it has been estimated that some forty or more millions of cords of wood are each year filling the air with no more valuable product than smoke

About five years ago some lumber companies popularly referred to as the 'Weyerhaeuser group," engaged the C F Burgess Laboratories to work upon this sawmill offal problem and see what, if anything, could be done to utilize it in some practical manner Numerous plans were considered such for example, as the manufacture of briquettes, the production of ethyl alcohol wood creosotes and oils, organic acids, etc , but all these proposals had such limitations that their commercial development did not appear particularly promising Some researches were then started with the object of embracing the more desirable features of the two primary wood using industries mentioned above namely the lumber and paper industries The question was asked 'If trees can be picked to individual fibers and these then put together again in thin sheets called paper, why cannot the trees be picked to pieces and put together in thicker sheets called boards, and thus actually make boards by altering the individual fiber and cell structure?



Interior of plant that makes four-foot-wide boards from previously worthless slabs and limbs, making 20 year-old timber serve in place of 150-year growth

Search for an answer to this question finally led to the development and manufacture of two new commercial products from living trees In order to carry on the commercial developments of the laboratory, the Weyerhaeuser companies organized a separate by product company, and this company built two plants at Cloquet Minnesota to manufacture the new products.

The first product to reach commercial development was a flexible, resilient felt like product called balsam wool It weighs only four pounds per cubic foot or one-third as much as cork This very unusual lightness accounts for the remarkable resistance balsam-wool offers to the passage of heat as the entire product is nothing but a mass of entrapped air cells and cavities in which all air circulation is almost entirely eliminated It allows only 0.1 British thermal units to pass through one square foot of its surface per one inch thickness, per one degree temperature drop in 24 hours. Expressed in another way, a layer of balsam wool only one-half inch thick, offers four times as much resistance to the escape of heat as maple or oak lumber of the same thickness This puts balsam-wool into the same "warmth giving" class of products as sheep's wool and the best of the hair felts, and very much better than products made from flax, cork, and other fibrous materials.

Balsam wool is made from living balsam, spruce and pine trees, the woods of which even when in a thoroughly dry condition, weigh over 20 pounds per cubic foot or more than five times that of the finished balsam wool made from them This great reduction in weight is brought about by cementing the individual fibers together after they have first been picked apart from the natural wood, so that in their rearranged condition they extend in all three cubical dimensions rather than in only two dimensions as occurs in forming a sheet of paper In fact the first steps in the manufacture of balsam wool are not unlike those practiced in paper making

The sawmill offal is first freed of foreign particles, such as stones, iron etc, and then cut into small chips which are run into a steel digester and cooked in the presence of an alkali, until the cementing material binding the fibers together is loosened The partially cooked chips are then mechanically beaten so that the fibers are knocked apart and the wood becomes a mass of individual fibers floating in water In this condition the individual fibers are then treated with a fireproofing compound so that they will not burn if exposed to flame They are then formed into sheets or laps and the moisture content reduced to air dryness, after which they are subjected to a very violent beating, which knocks the fibers apart in air and causes them to form a cloud of individual fibers. In this condition they are picked up by a large fan and blown through distributing hoods against a moving screen. These distributing hoods are so designed that the fibers are deposited upon the screen in a continuous and uniformly thick blanket six feet wide As the fibers pass from the distributor hoods to the screen they are blown through an atmosphere of cement in a highly atomized condition which causes the fibers to cement themselves together when they strike the screen.

Now unlike paper, the axes of the fibers extend in all three cubical dimensions, and this feature accounts for the remarkable porosity and extremely low density of the finished product The traveling screen then carries the blanket of fibers through a dryer where the water is evaporated and the fibers dried When the blanket emerges from the other end of the drier, the fibers are thoroughly dry and cemented together in an endless blanket about six feet wide and one and one-half inches thick At this stage, two sheets of tough kraft paper coated on the inside with a thin film of water- and moisture-proof asphalt are pressed against the blanket of wood fibers, and

(Continued on page 296)

The endless blanket of balsam-wool emerging from the machine

Machine-Gunning Auto Bandits

THIEVES, after committing a holdup or a robbery, are able to flee in motor cars because a policeman armed with only a regulation pistol, while pursuing the bandits, finds it difficult to shoot straight and "wing" the outlaws. This condition has caused the police departments of several of our large cities to adopt the submachine gun invented by General John T Thompson, who was director of arsenals and chief of small arms production during the world war

In order to show the effectiveness of this gun during a bandit chase a demonstration was recently carried out at Tenafly, N J The weapon was mounted in a side-car of a motorcycle and operated by a policeman The motorcycle pursued a seven passenger motor car supposed to contain thugs attempting to make a get away The auto was towed by another car a safe distance ahead These two were running at a fast clip and the motorcycle was about 50 yards to the rear The submachine gun operator opened fire on the "bandits'" car and a hail of 45 calibre bullets punctured its tires full of holes, bringing the machine to a halt It would have been an easy matter for the officer to hit any one sitting in the automobile and if the crooks armed with the best automatic pistols had tried to shoot the pursuing officer they would have found it extremely difficult to "get" him at a distance of 50 yards The odds were heavily against them from the moment the anti bandit gun opened fire

A demonstration was also made to show what the gun can really do to an automobile when this becomes the target of automatic firing At a distance of about 30 feet three of these guns blazed away simultaneously at the touring car just referred to and while it remained stationary Counting the combined fire of the three weapons, bullets poured into the car at the rate of over 2000 per minute And this fire reduced the machine to a pile of junk in less than a minutes time The tonneau was perforated till it looked like a Swiss cheese, the radiator was ripped to pieces and the gas tank and the steering gear were utterly wrecked Finally an incendiary bullet was shot in the spilled gasoline and instantly the car was a mass of flames

The anti-bandit gun has been made practical and safe within densely populated districts by the introduction of birdshot cartridges The latter, in conjunction with the marked accuracy of the weapon, insure the safety of innocent bystanders beyond the range of a few feet The birdshot cartridges will inflict severe punishment on a crook without fatally wounding him

The gun weighs only 9½ pounds and is, therefore the lightest rapid fire gun in existence The next lightest automatic gun weighs 18 pounds The weapon can easily be held in one hand and fired accurately It comprises but 38 parts as against 225 parts in the next simplest full automatic gun The gun is both a single-shot as well as a full automatic weapon

Submachine gun mounted in police side-car

Certain Gear-Shifting With a Foot-Loose Gear-Box

EVEN though gear boxes are nowadays so designed as to call for a minimum of skill from the driver, attention is always turned to devices that aim to eliminate entirely the human element from this important feature of automobile operation Mr A. E. Saxon, of Blackpool England, achieves this end by means of a secondary clutch behind the gear box, supplementing the usual clutch between engine and gear box The operating mechanism of this clutch is tied to the clutch pedal along with that of the regular clutch When the pedal is depressed in the usual way, both clutches are disengaged and the members attached to the gear box shaft are then brought in contact with clutch brakes bringing them to rest rapidly After engagement of the desired speed, the pedal is released, and the drive is transmitted through the two clutches This makes not alone for fool proof and fumble-proof shifting under ordinary circumstances but when the car begins to get out of control on a hill it permits a shift to a lower speed for the purpose of braking with the engine, at any speed at which the car may be rolling It is the simplest application we have seen of the multiple clutch idea most devices in this class having what amounts to a separate clutch for each speed Mr Saxon tells us that he has driven his car so equipped, for 5000 miles with no trouble and no alteration

Auxiliary clutch at rear of gear-box, designed to bring the gears to rest and permit easy shifting at any car speed

Fabric Bodies of Novel Type

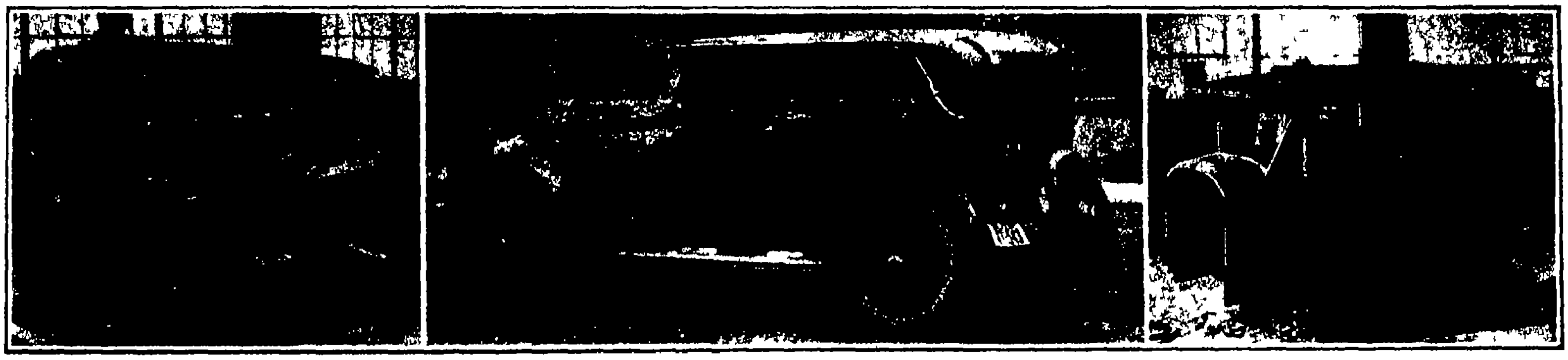
ONE of the most interesting novelties at the Paris show was the display of fabric bodies for closed cars Lightness durability and economy in construction are claimed for them The new type has the great advantage of requiring a comparatively small investment for machinery the labor cost is also lower This will enable the car manufacturer to bring out his closed models at a price that will appeal to a larger public than at present

In this country a fabric body was shown at the annual Automobile Salon held in New York in November winning the approval of the well to-do class of motorists who constitute the principal clientele of that exhibition and the interest of factory executives who also attended K I Childs, inventor of the fabric body developed here has subjected one of these jobs to a very satisfactory 12 month test during which it was driven some twenty thousand miles

The fabric body in Europe is built on what is called, after its originator the Weymann System It is an extremely light body with wooden frame members that do not touch each other but are joined by metal plates There are no longitudinal sills and the seats and floor boards rest directly on the chassis so that the body supports only its own weight It consists of a light frame over which the fabric is stretched

The American fabric body built on the Childs System is far more substantial in construction and durability It has the conventional wood frame construction used in standard practice with the addition of a few thin light strainers where panel contours are required Instead of the customary wood or metal panels a two-mesh No 19 gage galvanized wire is stretched over the frame, upon which are placed two layers of cotton wadding, which are tensioned into the wire by stretching over them tightly a number ten canvas This provides a strong but flexible panel over which is stretched the leather cloth This is specially made for the purpose and differs from ordinary artificial leathers in that it is a two ply or laminated fabric bonded with a special oil cement and the coating will retain its luster almost indefinitely

A number of body builders are already producing fabric bodies on the Childs System and it is asserted that over 3000 jobs are now in course of construction From the car owner's standpoint the principal advantages claimed for the fabric body are lighter weight with corresponding economy in operation elimination of the drumming, rumbling noises due to vibration, and the ease with which it is cared for and repaired To these may be added a lower first cost and a marked saving in insurance rates It seems that the insurance companies consider the fabric body, because of its strength and flexibility a safer risk than the wood or metal panel jobs, justifying lower rates



Left First step in construction of the fabric body a conventional wood frame being covered with coarse-mesh galvanized wire. *Center* Appearance of the finished job a custom made fabric body on a standard chassis. *Right* One layer of wire two of wadding and one of canvas having been applied the job is here shown ready for the application of the outer surface of leather cloth or other finishing material

Three stages in the manufacture of automobile bodies by a new process

Bombing the Battleship

Smoke Screens and Phosphorous Bombs Enable the Airman to Make Close-Up Attacks

A 100-pound phosphorous bomb hits fire-control platform of battleship This phosphorous umbrella would make sighting of guns a problem

MILITARY history shows that men have ever sought to secure the high places. There has been more blood spilled for the possession of hill tops ridges and towers than for any other objective High points have been desired for observation and for positions on which to plant batteries Aircraft have extended enormously the field of observation, and in the larger sizes they afford a movable and impregnable 'battery, which can hurl a shell larger than any gun ever devised

It does not take any flight of imagination to realize that the difference in shooting a bird on a limb and one flying is a matter of "leading" the target Nor does it require technical knowledge to understand that, if an airplane is flying out of sight, it cannot be easily picked off by anti aircraft fire It takes the keenest eyes to see aircraft at elevations of over twelve or fifteen thousand feet On the contrary if he makes use of smoke screens and smoke bombs, a pilot can bomb with comparative immunity at *one thousand feet or less* Much has been said about the value of tracer ammunition, but such ammunition is necessarily of different weight from ordinary ammunition and, since the burning up of the trail substance constantly diminishes the bullet's weight as it goes upward it is bound to traverse a path different from that of ordinary ammunition Using only tracer bullets would be a remedy for this fault but difficulties of supply are encountered During the war about one tracer bullet was allowed for each five regular bullets in aerial machine guns

To say that a bomb will not sink a battleship is like saying 'they can't put you in jail when you are already in It is natural for devotees of an old order to close their ears and eyes to any change If in the future, some means should be developed that would render airplanes helpless there would probably be a few veterans of the air services who would repeat all the way to the ground in a tail spin that it couldn't be done

When steam supplanted sails after a long struggle there were hardy old sailors who persistently declared that it would not last long The change from wooden to iron clad ships was made over a storm of naval pessimism that lasted for several years.

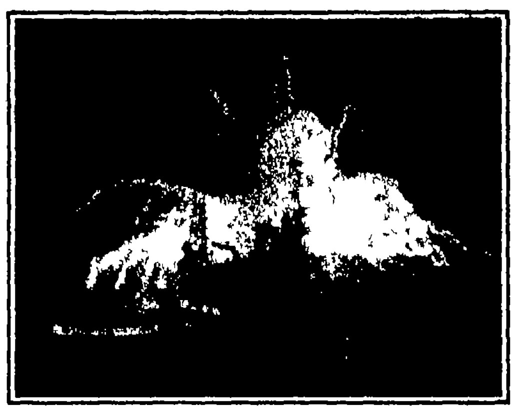
A bomb, whether laid in the water and exploding upon contact with a ship or whether dropped from an airplane or shot from a gun if it has sufficient explosive will sink the ship

There are aircraft that can carry a load of ten thousand pounds, but it is not necessary to drop any bomb of this weight in the vicinity of any battle fleet so far constructed Bombs of six hundred pounds or eleven hundred at the most are sufficient to place a ship even though she has steam up and her machinery running out of commission.

The claim has been made that all the bombing tests conducted so far have been against ships that were anchored and helpless, and the inference has been drawn that, were the ships moving and defended, aerial attacks would be harmless. But this is begging the question A battleship under steam, and carrying magazines of ammunition and a lot of delicate electrical equipment would be out of commission far more quickly than a so-called "dead' ship. The purpose of the bombing tests made so far has been merely to practice live bomb dropping and to discover the particular altitudes best suited for the particular bombs, etc The tests in 1921 showed that armored ships can be sunk not only by bombs placed directly upon them but by bombs that fall in the water near them The depth bomb has been fairly well developed. Be it remembered also, that tests in 1921 were carried out successfully against a radio-controlled ship with as much ease as against an anchored one It has been pointed out that the battleships used in the tests were obsolete. So were the airplanes. It is also significant that as many hits were scored upon towed or moving targets as upon those that were anchored

The point has been made that the percentage of hits by bombers has been very small but when this is said, *sinking shots* are meant. The large number of other shots that come close enough to a ship to disable her are ignored by the critics of bombing craft

The speed of ships is not sufficient to enable them, without rare good luck, to escape a pattern salvo covering a considerable area, such as aircraft can drop around the target It takes so long a time for a battleship to turn out of her course that bombs can fall from quite a height and still cover her Even if a ship completes a turn of 90 degrees nothing is gained for the pattern shots cannot be eluded Zig zagging to escape from aerial bombs is a useless maneuver

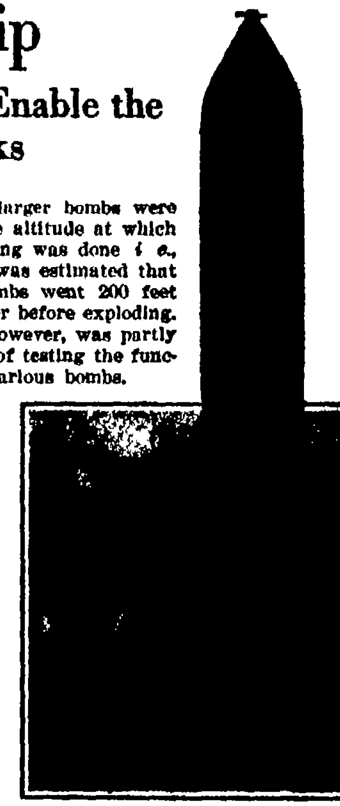


Anti aircraft gunners on this ship would have burning phosphorus fogging their gas-mask goggles and running down their backs

Dummy bombs drop differently from live bombs, and the personnel of the Army Air Service does not get much practice with live bombs. Hence, direct hits have not been quite so high on battleships as they will be

During the 1923 bombing of the "New Jersey" and "Virginia," the larger bombs were not timed for the altitude at which the actual bombing was done i. e., 11,000 feet It was estimated that some of the bombs went 200 feet beneath the water before exploding. The maneuver, however, was partly for the purpose of testing the functioning of the various bombs.

Anti-Aircraft Guns Useless



This 4000-pound bomb blasted a hole 50 feet wide and 20 feet deep. One hit would utterly disable or sink a battleship

Against a modern airplane with the pilot and the gasoline tank enclosed in armor, such ground fire as would reach the target would be deflected unless luckily placed Tracer ammunition, as stated, does not work out very well, when shot upward, because of its deflection Tracer bullets may make the same hole in a ground target at certain distances as regular bullets, but for air work their value is doubtful if not even detrimental, for their tail must swerve them as stated from the course followed by regular ammunition Several aviators have stated, unofficially, that in order to demonstrate the case they would hazard anti-aircraft fire from a battleship provided they were given the opportunity to drop bombs on her

To hit an airplane in the air several unknown conditions are involved If he is not using tracer ammunition, the ground gunner must know the speed of the airplane, its altitude, its distance, and the wind currents between He has no way of determining any of these factors and the spraying of a great quantity of bullets along the supposed path of the airplane is the only way of getting in even a chance hit It is easy to see that an anti aircraft gunner shooting from a rolling deck of a battleship would be at a great disadvantage, and the few seconds in which he would have to get in all of his shooting would lessen his chances of success.

In an attack upon battleships by airplanes, it might be expected that some airplanes would be destroyed. Even so this would be economy, for battleships cost so much more than airplanes that several airplanes with their crews could be sacrificed in order to sink only one battleship costing thirty to forty millions of dollars and its crew of a thousand men. When a trench is taken it is usually expected that some losses will occur

Such pictures as European countries publish in their journals showing bombing planes have significant characteristics Note the egg-shaped nacelles. Note the nose of the American Barling Bomber Such curved steel armor will afford very real protection to the personnel within these huge bodies. Airplane wings can be pretty well riddled without disastrous results. Big all metal armored airplanes would withstand machine fire with something of the impunity of a battleship exposed to rifle fire. Moreover, airplanes flying at a hundred miles an hour and more stay under fire but a very short time

It is frequently claimed that the only way to combat aircraft is with other aircraft, but when a battle-

(Continued on page 296)

Smoke bombs have been dropped to windward of this ship. Bombing planes could sweep down, just above this smoke and drop their bombs with deadly accuracy

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

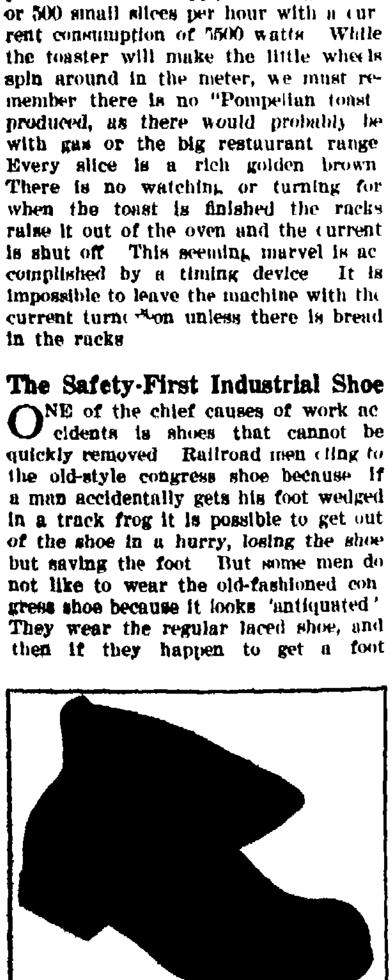
The electric toaster that takes the toast off the fire when it is done

Don't Burn Your Toast!

WHO has not burned toast? The electric toaster is the greatest offender in this matter but the problem has been solved even for the housewife if she can pay the price for an automatic toaster—of course a heavy duty toaster in a restaurant is no luxury even if it does cost nearly two hundred dollars, for it will toast for 150 to 200 persons. It will supply 360 large slices or 500 small slices per hour with a current consumption of 5500 watts. While the toaster will make the little wheels spin around in the meter, we must remember there is no "Pompeiian toast" produced, as there would probably be with gas or the big restaurant range. Every slice is a rich golden brown. There is no watching or turning for when the toast is finished the racks raise it out of the oven and the current is shut off. This seeming marvel is accomplished by a timing device. It is impossible to leave the machine with the current turned on unless there is bread in the racks.

The Safety-First Industrial Shoe

ONE of the chief causes of work accidents is shoes that cannot be quickly removed. Railroad men cling to the old-style congress shoe because if a man accidentally gets his foot wedged in a track frog it is possible to get out of the shoe in a hurry, losing the shoe but saving the foot. But some men do not like to wear the old-fashioned congress shoe because it looks 'antiquated.' They wear the regular laced shoe, and then if they happen to get a foot caught in machinery they often lose the foot because there is not enough time to unlace the shoe.

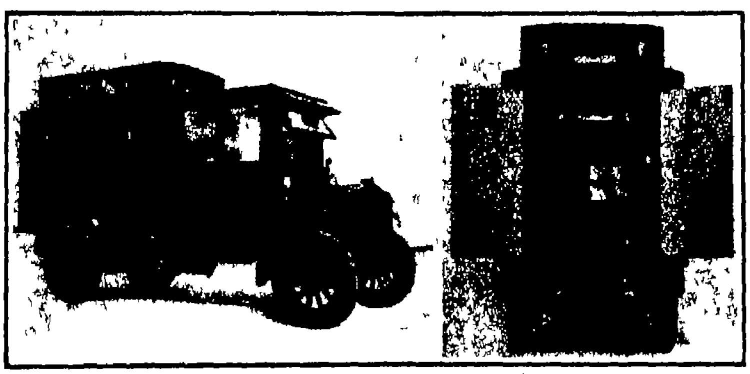


The shoe that can be shed in an emergency without stopping to unlace it

Realizing this fact, therefore a Boston manufacturer of shoes has found a way to combine the get-out-of-it quick quality with a resemblance to one modern type of footwear. This is made possible by the adoption of glove snaps. These snaps, are however extremely large and rugged for they are designed to hold fast until the wearer wishes to remove the shoe. Then all that is required is to seize the top of the shoe-flap and give it a strong tug after which the imperiled foot is quickly and safely withdrawn.

Security for the Payroll

THE body of the armored car here shown is of armored plates inside and out mounted on steel framework, and with a packing of dense felt between. The ventilators are protected on the inside with spring covers to offset the possible use of gas or tear bombs and are of bullet-proof glass. The ports are so placed that the occupants of the car can get a range on attackers from any angle and at two different levels. The port covers are so arranged that they open automatically to the pressure of a gun barrel from inside and close under spring pressure as the gun is withdrawn. The two sections of the windshield overlap along their junction line. The rear compartment is separated from the driver's seat by a partition equipped with a sliding door furnishing complete protection to guards even though the driver be overpowered. The body envelops the mudguards in such a way that there is no possibility of riding outside, and with the same end in view the front step folds up into vertical position when the door is closed. The rear compartment is equipped with an emergency lever that releases the clutch and applies the brakes so the car can be stopped and its further operation from the seat made impossible by the guards within. The body plates are welded at the corners, so that even should the car be overturned, the occupants would be safe. On the whole this is about the best thought-out car of the sort that we have seen in connection with the increased interest in them brought about by the increased vogue of payroll holdups.



Two views of the latest bandit-proof car

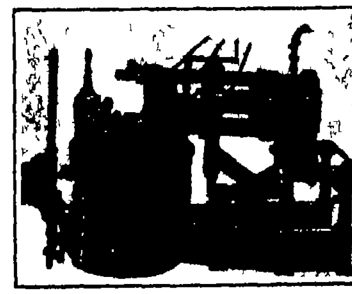
Casting Small Parts by Machine

MANY small parts of the automobile, adding machine, typewriter, phonograph, and other mechanical contrivances are now made by the die-casting process instead of the old machining method formerly used. The die-casting industry which has been developed in the United States in the last 20 years represents one of the greatest labor-saving processes used in mechanical production.

Die-castings are made of alloys having a base of either zinc, tin, lead or aluminum and running as high as 35,000 pounds per square inch in tensile strength. The castings are made in steel molds under varying pressures running as high as 400 pounds per square inch and are taken from the die cast accurately to .001 inch with smooth and uniform surfaces.

The machine which will supply this demand must be simple to operate, fool proof and capable of high production. A machine of this type has been developed during the last five years by F. X. Dollin of New York and a number of these machines are in operation both here and in England. Practically any intelligent workman can operate them as they are fool proof and absolutely safe. A great advantage is that they are interchangeable as to alloys; they will cast aluminum with high efficiency and may be changed over to the zinc, tin and lead alloys with equal efficiency. They relieve the operator of all the hard manual work opening and closing the dies and shooting the metal entirely by power. In addition they have ample power to pull cores and slides. The machines are sturdy and strong in design and are operated by two valves.

The method of heat regulation has been improved, making it absolutely reliable, and the alloys are handled in such a manner that deterioration by heat and absorption of iron is reduced to a minimum. The up-keep is low and they use very little power, a new patented method of using compressed air being employed.



Die-casting machine for the rapid production of small metal parts without machining

The Mullen Tester for Measuring the Quality of Paper

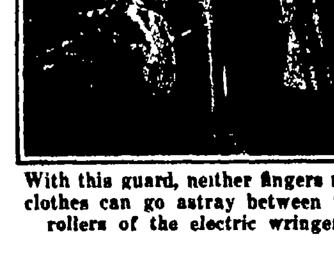
WHAT is known as the Mullen tester is used almost universally in this country for determining the bursting strength of paper, and on this factor is based to a large extent the measure of the quality of the paper. It often happens however that a sheet may be so made or so sized as to have a very high bursting strength and yet show up very poorly in a tearing or folding test.

The Bureau of Standards is working on a supplementary test employing two steel rollers which produce a crease in the paper under controlled conditions of pressure and time. The bursting strength is determined before and after such folding. The loss of strength under these conditions is an excellent indication of the brittleness of the paper. The method, however must still be standardized.

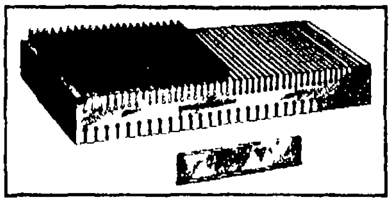
The Safety Wringer

ELECTRIC wringers are very wonderful conservators of elbow grease but there is one disadvantage which they have always possessed. When one is grinding away at a hand crank one can and will stop instantly at the slightest suggestion that the clothes are getting tangled or that any portion of one's anatomy is about to accompany them between the rollers. With the electric machine it is not possible to make such an abrupt stop by the time the danger has been noticed, the switch thrown and the impetus of the motor exhausted the damage has probably been accomplished.

There have doubtless been numerous guards designed for the electric wringer to prevent this but we believe the one we illustrate herewith the invention of W. S. Osgood of Chicago is distinctly novel. The device consists of two idle rollers carrying an endless canvas belt. The rollers are placed one before and one behind the business rollers of the wringer and the upper turn of the belt passes between these while the lower turn comes back between the lower roller and the drainboard. The belt carries the clothes between the wringer rollers in a continuous stream; they are fed on to it rather than into the jaw of the wringer. They adhere to the belt just as they adhere to one another under the wringer pressure and since the



With this guard, neither fingers nor clothes can go astray between the rollers of the electric wringer



Novel assembly of printers' rules that saves much time on large jobs

belt cannot possibly wrap around the wringer roller neither can the clothes And no part of the operator's anatomy can get close enough to the rollers to be carried between them so that fingers are quite as safe as the clothes themselves The guard can be attached to any wringer by turning two screws and once on may be left permanently in place

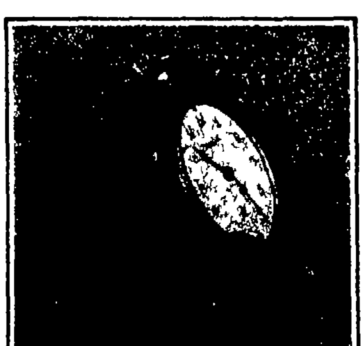
One Brush for the Whole Typewriter

SOMETHING new in the way of typewriter cleaning brushes is offered by a New York dealer Its three-in-one construction does away with the separate use of the three brushes that have heretofore been necessary to get at all parts of the machine that require cleaning The big fellow at the right end is a soft brush for the general work of cleaning between the keys or the type rods under the carriage etc The round affair mounted on the shaft at the left of the handle is a rotary brush which, it is claimed really cleans the keys and the handle is designed with a special view to making it easy to spin the thing by hand as the brush in question lies on the face of the type And the long lean brush at the extreme left goes into all the hard-to-get-at places and brings the dirt out with it Finally the maker drops the very foxy suggestion that there are lots of things besides typewriters in the average office that would be kept cleaner if there were a better way to clean them, and that this brush will be applicable to them

Three in one brush for more effective cleaning of typewriters and other office apparatus

Time for the Automobilist

SOME cars are manufactured with a clock on the instrument board or at least with a place for one others do not thus provide for the comfort of the driver who wants to know the time For use with those that do not, the stiff wire rack which we illustrate affords a very handy attachment It is easily screwed to the board by means of the metal base plate as shown and the watch from the driver's pocket, or one permanently devoted to use with the car is very easily fitted into the loop of the wire where it is held securely and with its face in plain view The wire, while heavy enough to hold its burden in safety is of such character that the loop can be squeezed down smaller or opened out larger to accommodate a watch of any size It is of steel covered with woven linen thread and its shock-absorbing arms protect the watch from injury Incidentally, the watch is held in such position that all the passengers, as well as the chauffeur, can read it



For the car that makes no provision for a clock

A New Way of Setting Ruled Jobs

FOR the job-printer who has enough rule-setting to justify a little initial expense there is now offered a most efficient scheme for cutting down the costs of this particular type of composition Slotted bases of the sort illustrated with rules to fit the slots tightly enough but not too tightly, are the foundation of the new idea The hole at the bottom of the slot, with the flange at the bottom of the slides prevent any catastrophe to the form after it is once arranged The idea is to use singly or in combination such of the bases as give the necessary length of rule and, for vertical rulings to set ordinary foundry rules between the bases at the desired points Where no vertical rule is wanted the bases may be fitted together flush and it is then contemplated that single slides be used, of sufficient length to span both (or all if more than two) bases, locking them together very nicely By setting rules in every slot, every alternate slot etc etc, each base is made to serve a wide range of duty In fact two separate models for the base each having a different measure between the slots on either face are sufficient for all the standard rule measures, and when each base is provided in ten different widths, from one to ten picas it is possible to make them up into combinations giving any desired width in steps of a half inch The rules themselves it is contemplated, will be made up by the individual user and he is advised to have these on hand in all lengths from one to 36 picas It need hardly be pointed out that, for a given face of rule, the same slides can be used with all bases In support of the claims made for the new way of setting ruled matter, a job is cited which took nearly an hour with the conventional rules and slugs and less than ten minutes with this apparatus

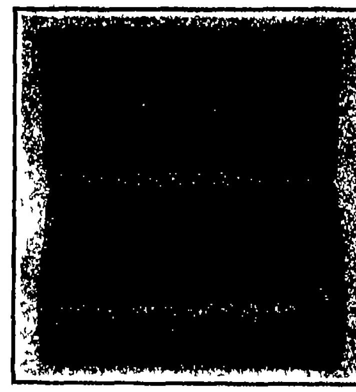
Salts Cause Rapid Decay of Building Stone

SEVERAL cases of stone decay in new buildings were found in the course of an inspection of two hundred stone buildings recently conducted by the Bureau of Standards The cause of this early decay appeared to be principally due to a recrystallization of soluble materials which had been leached out of the mass of the stonework or the mortar and had deposited as an efflorescence in certain places at the surface of the stone or slightly beneath it This phenomenon occurs frequently under the water table or under the cornice It has been noted in structures of different types of stone, but most often in those of sandstone

The same effect has been duplicated in the laboratory by placing blocks of stone partly immersed in a weak solution of sodium sulfate The salt is carried up in solution through the pores of the stone by capillarity and deposited as crystals on or slightly beneath the surface wherever evaporation occurs The expansion of the crystal causes disintegration of the stone in a manner similar to that of frost, but the process is much more rapid

Fresh Cigars from Every Box

THERE'S something in this box of cigars besides the smokes Look closely, and you will observe, in the right end, what might be almost anything, from a bomb to—well, to a tiny humidor, which is exactly what it is Carried thus in the cigar box, it enables the fastidious smoker to have his cigars in just the same condition, on the train or in the automobile as in his study at home So popular has the idea turned out to be that an eastern department store which offered one of these tiny humidors with every box of cigars had to reorder the humidors on a large scale, and has found a good sale for them separately, since the special offer expired



Miniature humidor for the cigar box or suit case

A New Discovery of Radium

FERGHANA in Russian Turkestan is the source of the newest supply of radium Pitchblend from which radium is reduced was for a time largely brought from Colorado Later discoveries of richer ore in the Belgian Congo have resulted in forcing some of the American developments out of business Now it is claimed that the Turkestan pitchblend is much richer than that from the Congo and efforts are being made to develop the new find at once for use in hospitals Our supply of radium is so limited that all that is recovered in the world could be placed in the palm of one hand—if one did not value the hand In America, radium is available in the larger centers, yet it is stated that not five per cent of the people who need treatment with radium can make use of it because there is not enough to go around A group of four unnamed American philanthropists have united for the purpose of securing, if possible the new supply from Turkestan and making it available to the public for medical use at cost

Much radium is used on watch dials and for other luminous objects such as pendants for locating electric lights in the dark This radium is usually in the form of radioactive barium sulfate and its luminescence lasts only three or four years After that it is for all practical purposes lost, since few individuals would find a way to return so small amount to any central source of supply A full pound of radium would be worth about $50 000 000

Judging the Fertility of a Soil

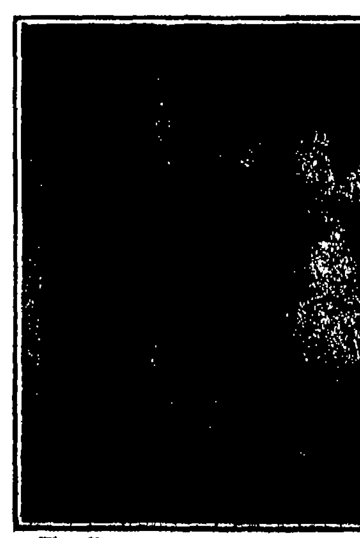
HOW to judge the condition of the soil of a farm or garden without planting a crop on it, and then waiting to see whether it is a success or a failure is a perennial question in agriculture According to *Soil Science*, one way of arriving at an opinion in any given case is to take a census of the bacteria microbes, and other infinitesimal organisms living in the soil in question

Counting the bacterial population of a 160-acre farm may seem a large order, but in practice it is no more difficult than to take a representative sample of the soil and have it tested by a bacteriologist, who will weigh out a small portion of the sample and mix it with a broth which microbes like Each microbe starts to raise a family or colony in its new surroundings, and when these colonies become large enough to be visible, they are counted, after that it is only a matter of arithmetic to arrive at a figure representing the bacterial population of the whole farm

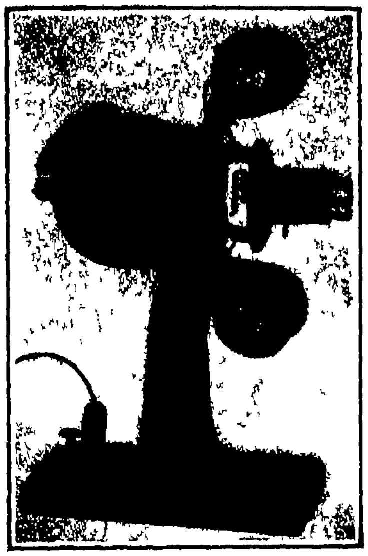
Like all other living beings, bacteria thrive best where food is most abundant, so that where a soil is found to be rich in these small organisms it is clear that the soil must also be rich in food elements Crop production has been found to be almost parallel with the number of microorganisms which the bacteriologists have counted in the soils, so the method of judging fertility by a bacterial count can be regarded as fairly reliable

A Laundry in a Closet

THIS caption is only half correct Perhaps it would be more truthful to say an ironer" in a closet, but after all ironing is half the battle for the "wet wash" if you send it out has to be ironed unless the laundry does all the work There are many housewives who have electric washers which do the work so quickly that Monday is not as blue as it was formerly but how about Tuesday with the dreaded ironing? Of course the electric iron has robbed Tuesday of its terrors, but still there is manual labor to be performed often in summer under exhausting conditions We went to a recent show of household appliances and we saw an ironer which was so interesting that we decided to illustrate it This was a complete ironer that disappeared in the wall or into the closet yet was ready at an instant's notice It ran with any kind of current on 110 or 220 direct or on alternating current 25 50 or 60 cycles It was heated by gas gasoline or gasoline gas, or nicest of all electricity One hour on this machine produces as much as five hours by hand and the workmanship is irreproachable The cost for a week's ironing is about 26 cents a week against one-half of the laundress's $4 10 per diem in our locality



The disappearing electric ironer



The machine that replaces the glass stereopticon slides with a strip of standard motion-picture film

Film Practice for the Stereopticon Lecture

THERE is now offered a miniature still picture projector which uses small strips of standard motion picture films, each strip containing from 50 to 300 separate views. A specially designed resistance cord eliminates the rheostat, and enables the machine to be used from any light connection. It uses a small standard incandescent lamp readily replaceable from any electric or automobile supply store. The whole apparatus together with several thousand pictures can be put in the drawer of a desk or in the bottom of a small hand grip. It will project at any distance from 30 inches to 30 feet. An insulating device protects the film from the heat of the lamp, so that a single picture may remain upon the screen for hours if need be. This makes it possible to hold a picture on the screen for protracted analysis or discussion. The film will move backward or forward, so that pictures far back or far ahead in the series may be instantly referred to. The convenience of carrying a small compact film roll instead of a large number of bulky and heavy glass slides need not be dilated upon.

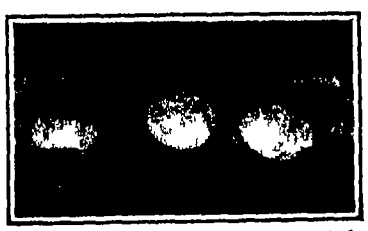
The new machine is designed to take the place of the stereopticon. Where now the pictures which are to be used are made up into a series of separate glass slides using this machine they will be laid down, one after another on the successive frames of an ordinary film strip. The instant availability of any picture in the series, the rapidity with which change can be made from one picture to another, or a series of several displayed, and the elimination of fire hazard, are conspicuous among the advantages gained—not to mention the greater ease of manufacture of films over glass, the increased convenience of transport, and freedom from breakage.

Better Nursing-Bottle Practice

BABY awakes in the middle of the night wailing and on investigation daddy discovers that baby didn't get all his dinner. Something went wrong with the nipple, and half the latest meal is still in the bottle. Mr. C. C. Campus of New York has analyzed this familiar situation, and decided what lies at its root. He points out that when the infant sucks milk through the nipple air must enter the bottle from somewhere, to take the place of the milk—or the milk can't leave. In the conventional nipple this air has to leak in through the same hole that the milk comes out of. Two-way traffic on a single-track road is no more impracticable than this.

So Mr. Campus has designed a new nursing bottle which he offers for the delight of all mothers and all babies. At the lower end, as illustrated, he pierces the glass with a large hole and around this hole he erects a circular shoulder of glass. Then it is simple to turn a regular nipple inside out and hang it over this shoulder so that it projects within the bottle. The hole in this nipple is smaller even than that through which the baby is accustomed to getting his milk, and the exposed inside of the nipple is filled with clean cotton. The net result is that no milk leaks out but with every pull that baby gives on the regular nipple, air leaks in. The advantages are not restricted to the smooth, regular feeding which the bottle is primarily aimed to provide, but include numerous other items.

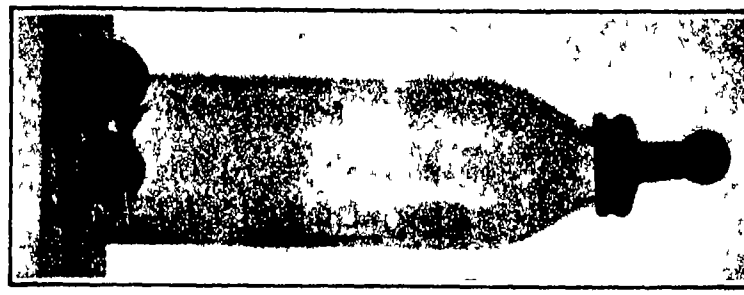
The air doesn't pass through the milk at all but goes direct from its entrance valve to the air space in the bottle—study the position of the nipple with reference to the milk when the bottle is tipped if you don't believe it. Mr. Campus believes that, even if the cotton had no filtering effect, this would preserve the milk a good deal better from the action of germs in the incoming air and he points out that there is less cooling action by the air on the milk. Certainly there are less air bubbles in the milk. Then when it is time to wash the bottle both nipples are removed and a clear flow of water through the bottle is achieved—something quite different from the usual procedure for cleaning the usual bottle.



Safety goggles for the be spectacled worker

A Different Chair Cushion

THIS rubber chair cushion is manufactured under a process which results in the rubber's acquiring the porous character of a sponge so that the pores permit ventilation as well as insuring coolness and comfort. The cushions thus made are about five-eighths inch thick and shaped to fit the average chair seat. They will not slip or slide over the polished surface of the latter, the rubber surfaces tending to hold them in one place on the seat of the chair.



The nursing bottle that is better for baby and easier to clean

The ventilated rubber chair-cushion

Combining Safety Goggles with Spectacles

NOT only workers in the industries but a very large number of people at work and at play find difficulty in getting goggles that may be worn over common spectacles without discomfort. Recognizing this fact a Reading Pa. manufacturer of goggles has placed on the market a special goggle for wear over the spectacles. These goggles are made up in a new form, the parts for either side being entirely separate. A simple spring clip attached to the inside of the cups enables them to be attached to the spectacles in a moment where they hold fast "like a bulldog to a root." The workman who clips this goggle to his spectacles is prepared for the eye hazards of his work. When his day's work is through he removes it as easily as he attached it. Taking human nature into account it is the extreme facility with which it may be attached, and the freedom from annoying slipping and looseness which may accompany the wearing of some goggles, especially when worn over glasses, that results in workmen omitting them "just for this time" and getting injured. The new style of goggle is most attractive in appearance and it is made up entirely of metal so that it may be cleaned by scalding. It is made to clip over a 1 9/16 inch standardized round industrial spectacle. Factories which see to it that those of their employees who must wear spectacles do not go without proper safety goggle protection will find in this device an opportunity to save on workman's compensation. The "goggles" are so neat that there would be no excuse for the men's not wearing them.

The Motion Display Sign

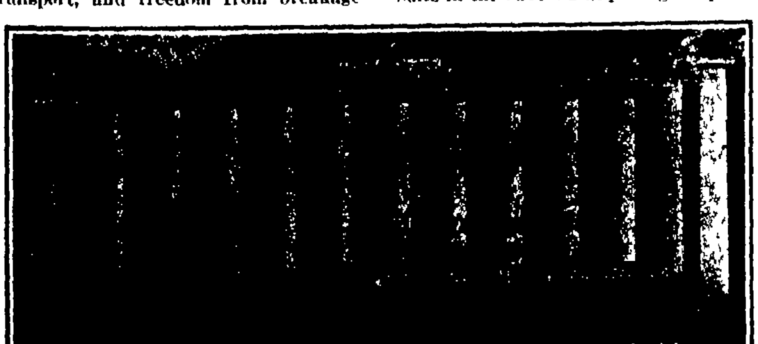
A LARGE motion display sign 43 feet long by $12\frac{1}{2}$ feet high showing three different pictorial displays at intervals of 10 seconds was recently placed in service on a prominent corner location in Kansas City. The sign is composed of a series of ten triangular metal drums, each drum $3\frac{1}{2}$ feet wide by 10 feet high, with the changing display face 34 feet long by 10 feet high inside the border of the sign. The drums are pivoted, top and bottom on ball bearings and are revolved in unison from one display position to another by an automatic mechanism housed in a dust proof case 18 inches square half filled with lubricating oil. The framework of the sign is light structural steel forms and the pictorial displays are painted across the entire 10 drums when alined in position. As the drums are identical in construction even larger signs may be built by adding more drums or increasing their height, as desired. Heavy rains and wind have shown this sign to be unaffected by weather.

The sign is operated by a small electric motor and is controlled by two 10-day time clocks which start the motor at 6:30 a. m. switch on the lights at dusk, and stop both sign and lights at midnight always with some one of the three display faces in alinement. At night the lights in the end post brackets change color with each display so that besides presenting a continuous moving picture outdoors during the day the variety of color at night is especially attractive.

The Thermos-Bottle Washing Machine

A HEAT-RETAINING tub built on the principle of the well-known "Thermos" bottle, is the outstanding feature of a new electric washing machine. How to retain the heat in the wash water in the washing machine has long been a problem to the housewife for it is declared that auxiliary heating attachments are very often unsatisfactory and troublesome and in time tend to yellow the white clothes. The tub of this machine is a double tub, built of copper and cypress. Between the outer tub of one-inch cypress and the inner tub of tinned copper is a vacuum and this "dead" space at the sides and underneath provides an insulation that is said to make the loss of heat practically impossible. Other features of the machine are the perforated aluminum

Washing machine with vacuum space around the tub to prevent loss of heat



The three-way advertising sign, caught in the act of making a shift

Unit construction of radiator, aimed at rapid replacement of a damaged tube

wings which swirl hot suds through the clothes at approximately one hundred times a minute, the aluminum wringer which swings completely around and has four fixed positions in which it can be securely held by a self-locking catch and the adjustable legs which may be raised or lowered as the housewife desires.

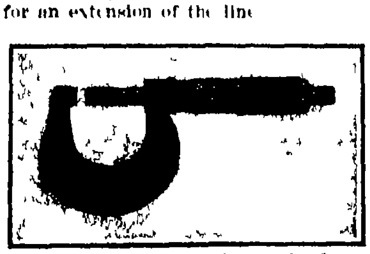
Quick-and-Easy Egg Separation

Separating white and yolk of an egg is an old kitchen trick but not such a simple one that a tool to facilitate it will be scorned by the housewife. A spoon with a slotted bowl is the answer. If an egg is dropped into this, the white runs through the slots while the yolk remains behind in the bowl (of the spoon). The spoon with the slots can be used for many other purposes as well. Potatoes are creamed with it, cake beaten, and on the end of its handle is a bottle cap remover.

Decimals and Sixty-Fourths with a Single Micrometer

The machine operator in many shops finds himself between the frying pan of the metric system and the fire of the half-quarter-eighth, etc., system of fractionating the inch. He gets some jobs that call for the one style of measurement and some that call for the other. He has been in the habit of meeting the situation by using two micrometers, or by using one micrometer with a card carrying a table of decimal equivalents. Now a New England manufacturer has conceived the bright idea of putting this table on the frame of the micrometer itself.

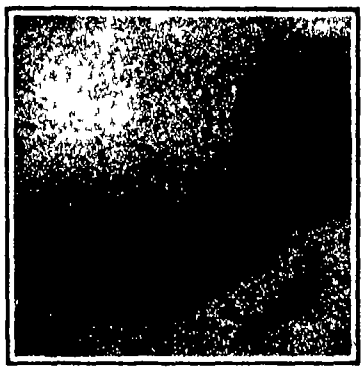
On one side are the decimal equivalents of eighths, sixteenths and thirty-seconds; on the other those of the odd sixty-fourths. The figures are raised on the frame rather than stamped in it so that they do not fill with dirt, and at the same time give better grip on the tool for oily or greasy work. And the tool itself embodies all the standard refinements of micrometer practice in addition to the new one. For the present the micrometer with decimal equivalents is supplied only in the one-inch size, but we should judge that demand will call for an extension of the line.



This micrometer carries on its bow the conversion table from 64ths to thousandths

Sectional Radiator for Easy Replacement

A radiator developed by a Wisconsin manufacturer for use on trucks or any type of gasoline engine used for construction work is interesting in that it is built in sections so that damaged units may be replaced with the minimum of time and expense. The special form of the core construction gives exceptionally great cooling capacity, it is claimed. Through this spiral core construction and the presence of a copper strip in each air cell centrifugal action on a column of air is produced during its passage through the radiator. Extra large water channels allow for a constant flow of free water with the minimum of danger from clogging or freezing. And when clogging or freezing do occur, repairs are made with a minimum of cost and a minimum time of lay up for the truck.



Slotted spoon for separating eggs

Steering with a Screw-Shaped Cam

Something distinctly new and decidedly interesting in steering gear is being introduced by a tool company of Lafayette, Ind. It is called by the manufacturers a cam and lever gear, though without any desire to quarrel with them we think a name more descriptive of the action of the prime member might have been found. This member is, in fact, more like a variable-pitch screw than a cam, the only apparent reason for calling it a cam is that a lever bears in it, and takes motion from it in a fashion that is in some slight way suggestive of cam action.

The screw member in question is at the lower end of the steering tube, and when the wheel turns, it turns with it. The diamond stud projection on the inner side of the lever, which engages with the "cam," then travels up or down according to the direction of cam rotation. This rotates the lever and through it the trunnion shaft and the steering arm.

In mid position the pitch of the cam is very slight and the motion of the front wheels slow, but as the pitch increases toward either end of the cam, the response of the wheels speeds up. In straight-ahead driving, the very low reduction of the gear in mid position eliminates practically all road shock. In making an actual turn the further the steering wheel goes around the faster the steering response, so that nothing like the wide swing of the wheel is needed here as on conventional worm steering gears. The lever arm inside the gear is very long, giving high leverage combined with claims of easy steering and long life.

An Ammeter for Heat

If an electrical engineer wanted to measure the resistance to electric current of a complicated piece of electrical apparatus, or of several of its parts which were connected in series, the easiest way to do it would be to measure with an ammeter the current flowing through the apparatus and then measure the voltage drop across the apparatus or across each part. From these the resistance can be calculated.

When the Bureau of Standards undertook to make measurements of the resistance offered to the flow of heat by different types of wall construction an apparatus somewhat similar in principle was devised. The amount of heat flowing through a wall panel is measured by a "conductimeter," which in itself offers little resistance to the flow of heat and then the temperature drops through the wall and through any desired portions of it are measured.

The tests thus outlined are made on panels built for the purpose, these panels being about three feet wide and six feet high. Thermocouples are attached to their inner and outer surfaces and are also built into the wall in various positions throughout its thickness. Other thermocouples measure the temperature of the air in the "house" and of the cold air "outside."

The conductimeter itself consists of a panel of wood three-fourths of an inch thick and eight inches square. Thermocouples are distributed over its surface by which the difference in temperature of the two sides can be measured. This is surrounded by a much larger wooden panel of the same thickness which is separated from the central panel by a small air gap. The purpose of the outer panel is to insure a parallel flow of heat through the conductimeter and the wall behind it and to do away with the edge effect which would otherwise have to be considered.

The wall panel under test is placed between two boxes which are lined with cork on all sides except the one against

The cam-and-lever steering gear, showing the lever in extreme position at the lower end of the screw-like cam

the panel which is open. One of these represents the inside of the house, and is heated by means of electric heating coils, the other represents the outside and is cooled by a refrigerating machine. The cold box and the room in which the apparatus is set up are kept at constant temperature by means of thermostats. The warm box is heated by current from a storage battery, which is so adjusted as to keep the proper temperature in the box. Temperatures are recorded continuously throughout the test.

With this apparatus tests on various types of walls are being undertaken. Panels already made up for testing represent frame construction with wooden siding, frame with stucco, brick with furring and brick without, hollow tile, with cells vertical and with cells horizontal, and concrete block. This technique for measuring heat conductivity and heat insulation is of extreme potential value to the building industry.

Electric iron with a soapstone body for storing heat

New Iron Stores Heat in Soapstone

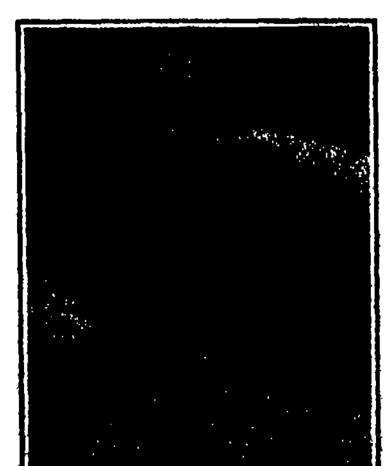
After about seven minutes of heating, the plug connection for this electric iron may be removed. The heat stored in the iron shaped piece of soapstone, will do the ironing for a period of 12 to 45 minutes. Its advantages are many, one of which is that a new soapstone can be replaced easily by the owner of the iron. It is not necessary to send it to a repair shop. It is practically scorchless and will not become overheated through carelessness.

Production of Solid Hydrogen

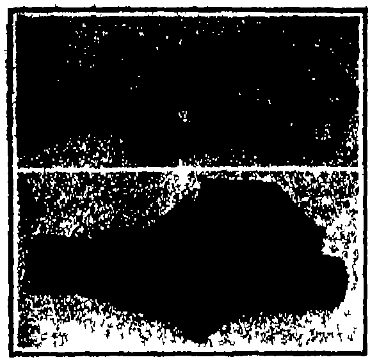
In connection with its study of materials at low temperatures, the cryogenic laboratory of the Bureau of Standards produced on February 21 about one liter of liquid hydrogen, part of which was later frozen into approximately 100 cc of frozen hydrogen. The temperature of this hydrogen "ice" was estimated to be about 437 degrees below zero Fahrenheit. This is the first time that solid hydrogen has been produced at the Bureau. Great difficulty is experienced in liquefying this lightest of all gases, because any impurities in the hydrogen, such as air, freeze solid before the hydrogen liquefies, clogging the apparatus. Using a special multiple wall vacuum container designed by Dr. C. W. Kanolt in charge of the low temperature work, it has been found possible to preserve liquid hydrogen for a much longer period than with the older forms.

The Sparkless Gas-Hose

The accompanying photo shows a nozzle that has been especially designed for the purpose of eliminating the possibility of a spark's starting a fire when such refined oils as gasoline are being delivered from tank wagon to steel drums. The new nozzle is tightly held in the opening in the steel drum, so that it is impossible to strike a spark. There is a spring, which is pressed inward when the nozzle is to be inserted into the opening of the drum. When released the spring holds the nozzle rigidly within the opening. The operator can then attend to other matters, without danger of the nozzle being jerked from the opening causing a waste of oil.



Establishing firm contact between hose and tank prevents the passing of sparks



Two views of a new stock-and-bushing assembly for threading the ends of pipes

Rapid-Fire Pipe Threading

ONE tool for cutting external screw threads on the ends of pipe of various diameters is now offered in an invention by James L. Lesslie, of Boston. The invention comprises a stock formed to receive and rotate any one of a quantity of interchangeable thread-cutting dies about a fixed pipe-end, as well as to hold this die coaxially with the pipe. In addition there is a bushing located at one side of the stock, and intended to be supported by the pipe itself during the cutting operation. This bushing then provides an elongated bearing of the appliance upon the pipe. Our upper view shows the stock, die and bushing disassembled, so far as is necessary to show their forms and relations, while the lower picture represents them in readiness for work. It may not be entirely superfluous to remark that the pipe that is to be threaded does not appear in either picture, the short pipe-lengths that do appear being merely the handles of the stock. It will be observed how the bushing is supported in offset position so that its hole falls in line with the cutting die.

How the Paper Tape Gets Around the Tire

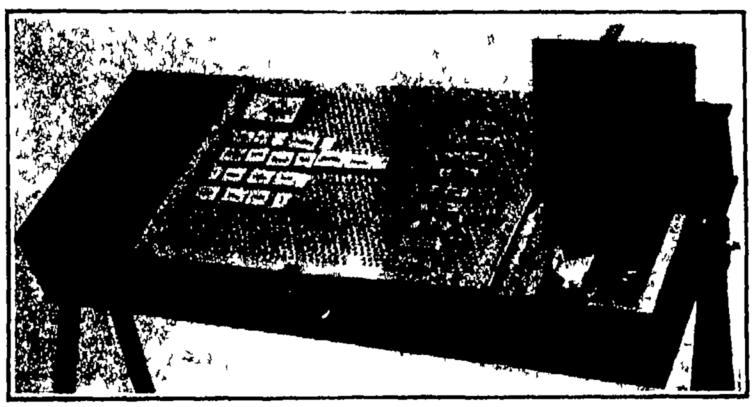
JUST before shipping tires a strip of paper is wrapped around them by an interesting machine and the time required for applying the paper and an advertising gummed tape is about ten seconds. The shuttle or head of the machine is ring-shaped and is opened by means of a hinged gate. When the tire is inserted and the gate closed a lever is pressed forward for compressing the beads so as to make a tight wrapping which prevents the slipping of the paper covering.

The clutch which engages the motor is made operative by means of pressing either the lever at the left of the machine or by stepping on a foot pedal. This brings the tire drums or sheaves into action, causing them to revolve at the proper speed, so that the pitch or advance is commensurate with the revolving shuttle.

Ten seconds per tire is the speed of this wrapping machine

Making a Game of the Tiny Tot's Education

FORMERLY a teacher and now a mother of three children Mrs. Verna Watkins of Atlanta has invented an educational toy which has the hearty endorsement of many teachers and authorities on child development. The desk illustrated is designed primarily for school use going from the kindergarten through the fourth grade. Its broad principle is simple enough: the perforated desk top combines with the shanks on the "pieces" to enable the child to set up, more readily and in much more stable form than would otherwise be possible, the letters, words or designs to which the pieces lend. It is in the flexibility of the last remark that the value of the device lies. Obviously words and numbers for reading and arithmetic lessons are the most elementary application. But the only limit lies in the ingenuity of the teacher or the parent. Everything from maps to an elaborate set up of barn yard scenery falls within the range of "Peggy," the very suggestive name adopted for the apparatus with its peg-bottomed auxiliaries. It makes every lesson a game and every game a lesson, and its inventor is confident that it will have a very wide application in the school, the home, the hospital, the Pullman car—wherever it is desired to keep children happily occupied.



The hole-topped table and the peg-bottomed pieces with which the little chap is cajoled into educating himself

Fog Alarms Operated by a Human Hair

AMONG the many automatic devices which stand between human life and death the 'fog valve' is about to take its place. This recently invented control enjoys a position unique among safeguards of life in that it depends for its successful operation upon several strands of human hair.

When a caller comes to your door you want the bell to ring. But wouldn't it be a nuisance if the bell rang continually? This, in a nutshell, was the problem faced prior to the invention of the fog valve in coping with the dangerous fogs which from time to time invade our coasts, and make navigation particularly dangerous.

Under the old system, fog bells and whistles were kept continually on many unattended lighthouses and buoys. While necessary this practice had two very distinct disadvantages. The first was of course, the additional expense of having this machinery operating 24 hours a day, when frequently there was no need for it. The second was that in places where the buoys or lighthouses were placed in close proximity to towns the continual sounding of fog signals was annoying to those within hearing distance.

A way has now been found to make the dreaded fog sound a warning against itself. Several strands of human hair are stretched across a wooden frame. Each hair is about 17 inches long and at each end is attached to very sensitive springs. As the fog comes rolling in on the coast, and the atmosphere reaches a point approximating 95 degrees of humidity, the strands of hair expand. This elongation though slight is sufficient to set in operation automatic fog bells, whistles and sirens. As long as the fog remains, the hairs stay expanded, and the signals continue to warn mariners of dangerous rocks and reefs which cannot be seen.

As the fog recedes the hair strands slowly dry out. This action takes about an hour and a half. At the end of this time the hairs have dried, contracted, closed the valve and the signals are shut off.

While it is possible to operate the device with any kind of human hair Mr. Hingsburg explains that hair from Chinese queues is being used in their manufacture. This is because it is uniformly long, tough and black. Another important factor in favor of the use of the Chinese hair is that unlike the hair of another race, it is round not oval. This aids in uniform expansion. The hair is first treated by a special process to remove all grease or other covering which might make it less sensitive to the action of moisture.

Already three of the valves have been placed in operation, one being at Lambert's Point, Norfolk. No publicity has been given this installation of automatic controls by the Government Lighthouse Service and many people in the vicinity of the three now in operation believe that the signals are being turned on and off as need arises by human hands. The utmost confidence is placed in the new invention by officials of the Lighthouse Service. It is really an adaption of a device employed in the British airplane service and described in these columns several years ago.

A Combination Chain Bolt and Alarm

THE old chain bolt for apartment or house door protection has been considerably improved.

Here is a combination chain bolt and alarm bell. As illustrated the door may be left open for ventilation purposes on a warm day. If pressure is used on the outside it will start ringing the miniature Big Ben which is a part of the combination.

Bell is wound by turning by hand after the chain is secured as shown. If the bolt is placed in the hole opposite where it is now located it supplies an alarm and protection when the door is fully closed.

Indicator that gages cylindrical work while it is in motion

Gaging on the Fly

DESIGNED for use in gaging cylindrical work while it is being rotated a new indicating device has been developed by an Ohio manufacturer. The device requires only a few seconds to adjust and by means of a clamping screw in the base it can be swiveled in either direction. The connecting link with which the device is slotted makes it convenient for the operator to set the gaging pin at any angle. The dial is connected with the gaging pin which rests against the work and registers the job measurement in thousandths.

An Unbreakable Cigar

PROFESSORS James S. Long and Henry Ullman of the Chemistry Department of Lehigh University, Bethlehem, Pennsylvania, after a year of research work have successfully discovered a method of treating cigars so that they will not break in the pocket.

They concentrated their attention on the binder of the cigar which is its strength. It was found that tobacco stems which are left over after the tobacco leaf is stripped and which have been considered as refuse, would make a very tough paper-like material resembling a tobacco leaf when rolled out on a paper pulp machine.

To preserve its odor a liquid which was pressed from tobacco leaves was mixed with it when it was rolled out. This made a very desirable binder but when smoked it gave an odor like that from burnt paper. The problem was how were the chemists to restore the tobacco odor.

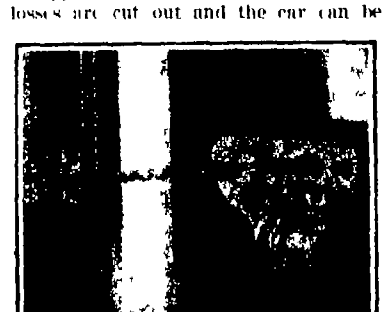
There was no mechanical means by which this could be done. In experimenting chemically it was to be remembered that the law permits the use only of a few chemicals in cigars.

After tests extending over the period of a year a chemical substance was discovered.

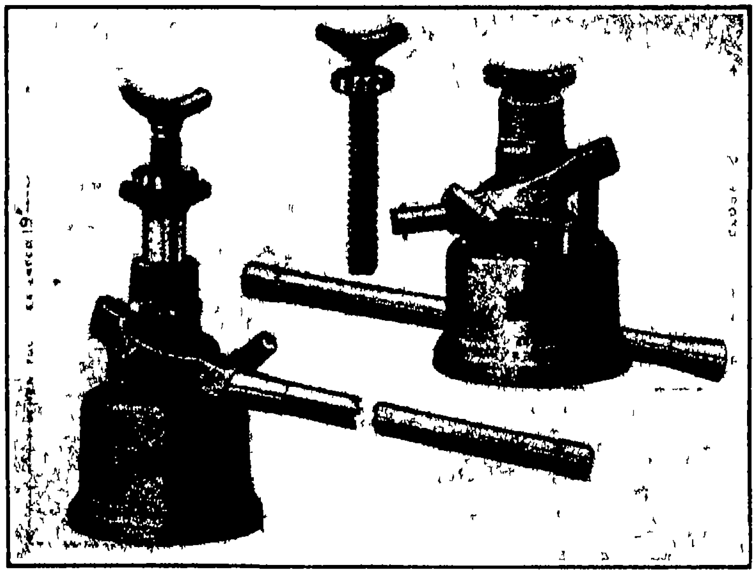
In fact they discovered two things: that the refuse part of the tobacco plant can be utilized in the manufacture of cigars and that cigars can be made of such a durable binder that they can be carried without any risk of breaking.

New Hydraulic Jack for Motorists

JACKS of the screw type waste nearly all the effort applied in overcoming friction between the spindle and the nut. By applying the hydraulic system these losses are cut out and the car can be



Chain bolt that rings an alarm when it is meddled with



Assembled and disassembled views of the new hydraulic auto jack

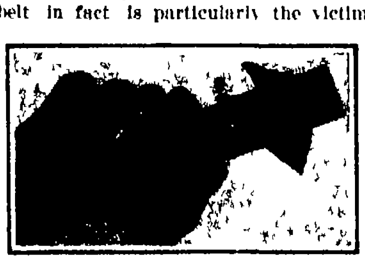
lifted far more easily—jacking becomes a pleasure rather than a burden.

The base of a new British hydraulic jack consists of an aluminum alloy casting, measuring about six inches in diameter. The plunger carries a screw extension, its length is adjusted once and for all for a certain make of car, so that the jaw is just underneath the axle. Pressure is generated by two pump cylinders one at each side of the gland fitting in the center of the base top. In this manner lifting is carried out during the up and down strokes and the wheel is quickly lifted off the ground.

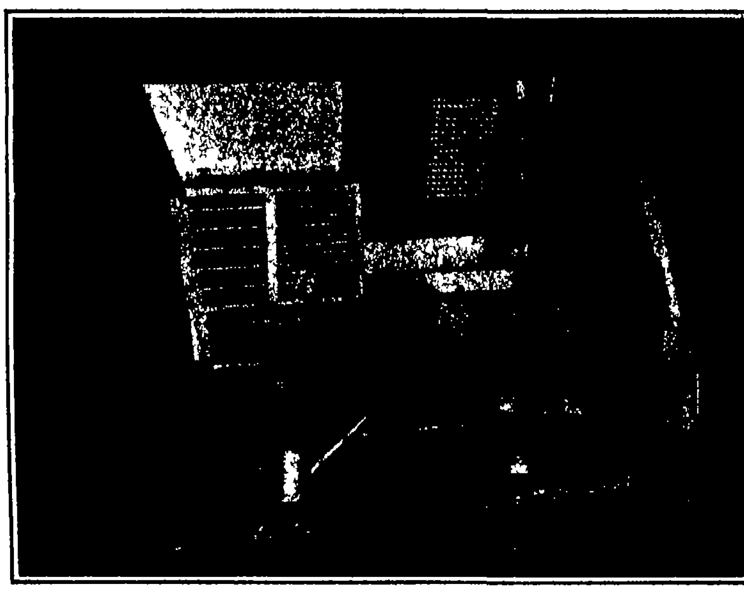
The jack is released by attaching the handle the end of which has a bayonet fitting to the release valve at the side of the pump cylinders on depressing the lever the liquid returns from the cylinder into the base, which acts as a storage chamber. When closed the jack is 8½ inches high fully extended it measures 19 inches. The axle of a three-ton car can be lifted without any great effort. The total weight of the complete jack is only 14 pounds.

Longer Life for Auto Fan Belt

WHEN you get a complete automobile starting system included for less than $400 you naturally don't expect that it will stand up, without replacement of any essential part, as long as one that sets you back a couple of thousand more or less. And experience bears out this expectation. In some respects the vehicle affectionately known as Lizzie displays the most extraordinary endurance. In others she is decidedly a short lived creature. Every owner finds that some one particular portion of her anatomy gives him more trouble than all the rest combined. Sometimes it is the brake and transmission bands that simply will not stand up; occasionally the connecting rod and crank shaft bearings go before their appointed time, more often the timer is the weak element. The majority vote of flivver owners would probably pick either the timer or the fan belt as her most frequently replaced member. The fan belt in fact is particularly the victim of poor design; the diameter of the upper pulley is so small that the belt is obliged to turn a corner sharper than any belt ought to turn and the result is early failure. We know of one of these cars that never got more than 2000 miles out of a fan belt—until it tried the one illustrated herewith. To the evident explanation of the structure of this belt afforded by the picture little need be said, save that the lack of flexibility suggested by the photograph is not realized in the belt itself. Barring a little difficulty in getting it to pass through the space between the crank ratchet and the end of the crank shaft, it is entirely a good belt and on the car mentioned it is still running after some 5000 miles. That in fact is its mission in life—to give the proprietor of Lizzie a belt that will outlast the one supplied by her manufacturer. This, it emphatically does. The secret is claimed to lie in resiliency; the belt is "built to give and come back."



Showing the construction of the longer-mileage fan-belt

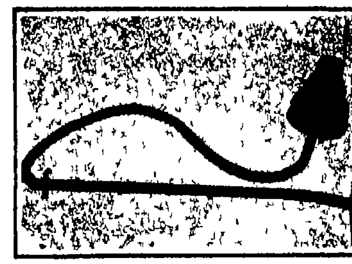


Bath and kitchen in one interchangeable unit for the bachelor and the bachelor maiden

A Baby Giant Among Vacuum Cleaners

SEVEN and a half pounds for a vacuum cleaner, complete with all attachments sounds like a wild dream but it is none the less realized in the outfit illustrated. And not alone in lightness, but in several other ways the new vacuum eliminates some of the annoyances of the old. It has bronze bearings of special design, automatically lubricated, so that no oil need be put in over a period of from three to five years. Portability is extreme, as the picture suggests. The terminals, always a source of trouble requiring service in the conventional electrical apparatus are protected by vulcanized rubbers fitted to the cord *in such a way that no bending or pulling of the cord puts any strain upon the terminals*, as a result contact is always positive. The bag is concealed and protected, yet can be emptied with less annoyance than in more familiar types, the maker tells us. There are no wheels or springs and no switches.

A somewhat similar principle has been followed in developing a small vacuum cleaner for cleaning the automobile upholstery.



Cutting down the weight and complexities of the vacuum cleaner

Saving Space in the Midget Apartment

WE have commented on these pages, we believe, upon the modern tendency in invention to combine two useful articles into one. Sometimes this tendency is properly a subject for satire. In our own humorous moments we employ, as a representative of inventions of the sort an allegorical "combination baby carriage and spark plug wrench." And a friend who is given to putting his humor into practice recently sent us a very neat little leather case on the outside of which was stamped in gold letters "So-and-so's patent combination cigar lighter and over-coat hanger." Opening the thing up, two inner compartments were revealed. In one of which reposed a match and in the other a wire nail.

Not all inventions of the combination type are ludicrous, however, and of those that deserve to be taken seriously we illustrate one. It sounds at first thought as though a combination kitchenette and bath room might be a joke too rather than a serious proposition but our picture will deny this. For those who live alone in a room and a half, be they bachelors of the original variety or bachelor maids, the saving of space effected by using the same unit for bath and kitchen is a decided object—to say nothing of the somewhat reduced rent which the elimination of plumbing permits. The *modus operandi* consists in the main of a removable top for the bath tub. When this top is put on, a fold up sink and a plate-rack are revealed in it and on it, when it is off, the same water supply feeds the bath. Both bath and kitchen are distinctly pint size—but that is no novelty to the people to whom this invention is addressed.

A Hanger for the Paint Pot

ONE of the many troubles of the amateur painter especially on outdoor work is to keep the paint pot within ready reach and yet out of danger of being upset. In this connection the little hanger device developed by a Middle West manufacturer is of prime interest. Simple as this device is, it may be used to hold the paint pot almost anywhere. Considerable leverage is formed by the feet and the point as will be observed in our illustration showing the device hanging on the side of a house, as well as the second illustration showing it holding on to the trim of the eaves.

The usual method of holding the pot of paint is an S shaped piece of iron wire which serves to hold the paint pot suspended from a ladder rung.

A novel disposition of the painter's pot

The Wandering Rifle Bullet

SOME very interesting considerations concerning the path taken by the bullet fired from the rifle now in use by the United States Army have been raised by a letter of inquiry received from a reader of the SCIENTIFIC AMERICAN This reader had been told by someone that soldiers are instructed to aim below and to the left of the bull's-eye, and asks whether the bullet does not fly straight to the point at which it is aimed

It is a fact that the bullet does not follow a straight path, having two well-established horizontal deviations in addition to those caused by the wind But other more important reasons are assigned for sometimes aiming below and to the left of the bull's-eye and these will be given after a careful description of the interesting horizontal deviations

We will imagine that the rifleman is shooting across a level plain, and that there is not a breath of wind Some magic enables him to observe the bullet through its whole trajectory When the rifle which is the United States Magazine Rifle, Model of 1903, is fired, the bullet "jumps" to the left after it leaves the muzzle and at 300 yards it is about half an inch to the left of the prolonged axis of the bore. From this point an increasingly rapid drift to the right begins and carries the bullet back across the prolonged axis of the bore at about 500 yards from the muzzle At 1000 yards the right hand drift deviation is 13 inches. At 2000 yards it has increased to 12⅛ feet, while at 2850 yards, the limit for which the rifle is sighted, it is 40 feet About half of the drift is corrected automatically by the sightleaf but the jump to the left is so insignificant that it is ignored It is simply an interesting phenomena No satisfactory explanation of it has ever been given, but that there is a jump to the left is certain because if a rifle be placed in a vise and fired at a succession of paper planes placed at right angles to the line of sight the holes made by the bullet do not line up truly

The drift to the right has a simple explanation, however As the bullet leaves the muzzle it is drawn down by the force of gravity This causes the air beneath it to become compressed, leaving a corresponding rarefication above it The bullet rolls on this cushion of compressed air, and since it is spinning at an exceedingly high rate, caused by the right hand twist of the rifling of the bore, which makes a complete turn every ten inches, this action is wholly comprehensible The folding sightleaf of the rear sight contains a slide whose purpose is to elevate the peepsight in order to compensate for different ranges But instead of raising the peepsight only vertically it at the same time moves it slightly to the left

The rifleman ignores the jump to the left entirely, he cannot split inches in his shooting no matter how expert he may be He can generally ignore the drift to the right also because it is not very appreciable at the 100 200, 300 and 500 yard ranges at which he does most of his shooting In fact up to 500 yards its only effect is in counteraction of the slight jump to the left

These conditions are wholly independent of windage For this, the proper corrections are made by a screw which moves the entire rear sight to left or to right by points marked on the windage scale, and the rifleman must know how to calculate windage by rule and not guess at it

It is a fact that recruits have sometimes been instructed to hold to the left of the bull's eye because the tyro is apt to yank the trigger instead of slowly squeezing it, thus introducing an error which it is the hope of a tired or careless instructor to correct by the poor advice to hold to the left

There are three possible reasons for instructing men to hold under the bull's-eye First, nine out of ten people tend to shoot too high This seems to be a matter of psychology Often it is caused by faulty position and holding But an instructor may have failed to impress the pupil with the necessity of learning to aim at what he wishes to hit and to make his corrections by means of the movable vertical and horizontal adjustments of the rear sight, so he may advise aiming quite far below the bull's-eye in order to counteract the common error

There remains one special case in which men are justifiably instructed to aim below the bull's-eye when using the battlesight This sight cannot be moved up or down to compensate for different ranges It is fixed, as far as its vertical range is concerned and it was arbitrarily set at 547 yards This was because the Russo-Japanese war had just been fought when the army rifle was first issued and the long range fighting of that war influenced the judgment of the designers so greatly that the sight was fixed at what is now regarded as too great a distance for average battle conditions Since at 500 yards the 'drop' of the bullet known as the summit of trajectory is about 30 inches, it is evident that at ranges under 500 yards the bullet may fly high by something under that much

Of course, the battlesight need not be used There are four other sights on the rear of the rifle and one, the peepsight can be run down to 100 yards But this always takes time, the aiming cannot be done quite so quickly with the peep and some men always manage to set it incorrectly Hence the use of the battlesight with the accompanying advice to aim below the bull's eye The rifle used by the United States Army is essentially an instrument of precision and permits of making accurate corrections for the various deviations of the bullet However this is not the cruder weapon used in the late war

Sulfur and Its Many Uses

TO THE average person sulfur is of apparently little significance He associates it with the slow burning match, the candle that is burnt in sick rooms after contagious diseases Popular conception has it that the lord of the nether regions is a close friend of sulfur, using it to herald his comings and to fill his domains with its asphyxiating fumes, as an emblem of his dread personage. A few may know that sulfur is an ingredient of gunpowder, but this is generally as far as common knowledge goes

Originally practically all of the native sulfur came from the mines in Sicily The abundance of the deposits and the ease of mining made the processes of recovering the sulfur very crude and inefficient A great deal of the sulfur was formerly allowed to go to waste, it was actually burnt up during the refining operation Today, the United States is a leading factor in the sulfur production of the world As far back as 1868 it was known that sulfur existed in Louisiana, buried under quicksands and marsh land The problem was to get it to the surface This was solved in masterly manner by the chemist Frasch, and today large sulfur deposits in Louisiana and Texas as well are being worked American competition has served to improve the sulfur extraction processes used in the Sicilian mines, it has resulted in an improvement throughout the entire industry It has made possible the freedom of American chemical enterprise from unstable and unreliable foreign economic conditions and as a whole has stabilized the sulfur industry of the world

Sulfur is a peculiar substance It has a dual, in fact a triple, personality It exists in three distinct forms and in each case it is just sulfur and nothing else, although its physical appearance is entirely different Thus, for example, in one form it is crystalline, a bright yellow powdery substance in another form it is plastic and amorphous, without any particular shape or form It is stringy and can be pulled out like a rubber band, furthermore, it is dark colored, at times almost black

Sulfur also behaves peculiarly when it is heated At first it melts. Then as heat is applied further, it becomes hard again and finally on continual heating it liquefies once more More heating will cause it to distill. It is just this property of sulfur that makes it possible to work the Louisianian and Texan mines These deposits are far below the surface they were located accidentally in the search for petroleum The mining is simple and effective A well is drilled just like in drilling for oil After the casing is in place, two pipes are lowered. Hot water is passed down one tube. On reaching the sulfur, which is mixed with gypsum and other foreign substances, the hot water melts the sulfur, converting it into a liquid The molten sulfur is then forced up the other tube by means of compressed air The molten sulfur is allowed to run out in enclosures built right on the open surface and surrounded with wooden forms The sulfur solidifies in a solid mass and is allowed to remain so until ready for shipment when it is blasted out and scooped up by means of bucket scoops The sulfur wells are exhausted in time and then the tubing is lifted out, the well is closed and another one is drilled elsewhere on the location The sulfur, that is mined in this way, is 99.9 per cent pure containing but a few hundredths of a percent of mineral oil, petroleum, in addition to traces of other impurities

Sulfur is one of the most important raw materials found in the earth In the chemical and allied industries, such as rubber, food, paper insecticide, etc, it plays a very essential role more so than any other chemical element First and foremost of its uses is the manufacture of the 'king of chemicals,' sulfuric acid whose consumption is said to measure the progress of all industrial enterprise Most people do not realize the peculiar significance of sulfuric acid, how much their welfare depends upon it

The food that we eat is fertilized with materials that are made with the aid of sulfuric acid the dyes that are used to color our fabrics the gasoline that drives our motor cars the lubricating oil that oils the bearings of our machines, the metals that are made into various articles of adornment and household utensils such as knives, forks etc, are all made with the aid of sulfuric acid The pure water that we drink may be purified freed of its algae content through the aid of a product of sulfuric acid copper sulfate The acid enters into the process of dyeing, bleaching and finishing of all textile fabrics It is responsible for the dynamite that blasts out our coal for the celluloid that is made into toilet articles, for the moving picture films that entertain us after the hard day's work is over The acid is used to make various products that enter into the manufacture of soap glass perfumes drugs and many other products In fact we can scarcely use an article that is not related to sulfuric acid in some way Hence it is not strange that the acid has been called the barometer of business the indicator of the prosperity of the country The importance of sulfur more than half the production of which is employed in making sulfuric acid is thus evident from this one use of the substance

But there are other important uses of sulfur as well For example, the paper on which the daily journals are printed is made with the aid of sulfur The sulfur is utilized in the making of sulfite pulp, which is made up into cheap paper and which is also used in the manufacture of artificial silks, explosives, plastic compositions and as a binder in making asbestos paper and boards Furthermore sulfur is used as such in fertilizers It is added directly to the fertilizer composition which is then mixed into the soil The particular value of sulfur for this purpose lies in the fact that the bacteria in the soil change it into sulfuric acid in time which then acts upon the other ingredients of the fertilizer principally the phosphates, and makes them available for plant food

It may be news to the majority of people that sulfur is used in the treatment of certain foods which are very familiar to them Practically all dried foods are subjected to the action of sulfur fumes Dried apples, apricots peaches prunes are treated in this manner Almonds are bleached with sulfur dioxide which is the gas obtained by burning sulfur Barley, figs grape juice, hops molasses, maraschino cherries, oats pears, peanuts raisins sugar are a few food products that are treated with this gas during the manufacturing process

Sulfur or rather the fumes from burning sulfur, are utilized in bleaching broom from which brooms are made cotton, felt feathers, furs hair hemp for making ropes, jute linen paper, rattan for making furniture straw for making straw hats wool wicker furniture willow ware and many other products Sulfur is used for setting heavy engines dynamos and other pieces of machinery on their foundations This is accomplished by pouring the molten sulfur around the bolts to embed them in the concrete A good cement can be made from a mixture of sulfur and cement which can be used for special purposes where it is desirable to fill in openings and at the same time take advantage of the antiseptic properties of the sulfur Sulfur may be added to the water used by cattle and other stock so as to keep them healthy It is used in medicinal preparations for the treatment of human ailments as well

Parcels are often disinfected by means of sulfur fumes It has been found that the ordinary form of taper a piece of paper dipped in molten sulfur, does not work so well due to the sulfur dripping off so there has been devised the simple means of impregnating ordinary pipe cleaners in sulfur and using these tapers for various purposes They can be hung in casks and barrels without any danger of the burning sulfur dripping off They may be employed to locate leaks in ammonia lines in refrigerating and ice plants The burning sulfur produces a white cloud wherever the ammonia is escaping Florists find them useful in bleaching violets, orchids and other flowers They are very useful for removing spots and stains from linen They are used in hospitals as deodorants and fumigants and by bee-culturists in cleaning the bee-hives.

The Heavens in April, 1924

The Astronomer Adds an Extension to the Yard-Stick that He Uses on the Skies

By Professor Henry Norris Russell, Ph.D.

A COUPLE of months ago, we spoke of the measurement of the distances of the nearer stars By direct methods of range-finding we can get out to about a hundred light years with tolerable certainty By studying the motions of the stars across the sky, and utilizing the apparent drift produced by the sun s motion in space, we can find the average distance of groups of stars with a precision of 10 or 20 per cent, even up to a thousand light years—provided we have good observations and enough stars to work with

To measure greater distances we must find another means—and one of the most notable triumphs of modern astronomy has been the development of the new photometric methods of determining the distances of the stars. If we can find out in any reliable way, how bright a star really is, and can measure how bright it looks, it is a very simple matter to figure how far off it is—and this method evidently reaches to the greatest distances at which one can see the stars at all The obvious difficulty is to find some test by which we can pick out stars of some definite degree of real brightness but several such tests are known

A very important one based on certain details of the spectrum forms the foundation of the famous spectroscopic method of Adams and his colleagues at Mount Wilson Another used most effectively by Shapley depends upon the fact—recognized long ago by Miss Leavitt at Harvard—that, among the variable stars of a certain type (called usually the Cepheid variables), there is a very close relation between the period and the actual brightness These stars vary in a highly characteristic manner—continuously regularly and periodically—so that they can be identified with certainty as of this sort even if they are so faint that they appear at most, as mere specks on our best photographs

Great numbers of them are found in the Magellanic Clouds—those strange particles of light like bits broken loose from the Milky Way, which appear in the southern heavens and bear the name of the great navigator who first discovered them Miss Leavitt, having worked out the periods of a number of the stars in the smaller of these clouds found a singularly precise relation between their periods and their average brightness—the latter steadily diminishing, from periods of 100 days to those of a day through some six magnitudes Later work reveals the presence of many stars of even shorter period down to half a day which are still fainter, though not much so Since these stars are all known to be really in the cloud and therefore at nearly the same distance from us, their real luminosities must be in the same proportion as those with which they appear to us to shine

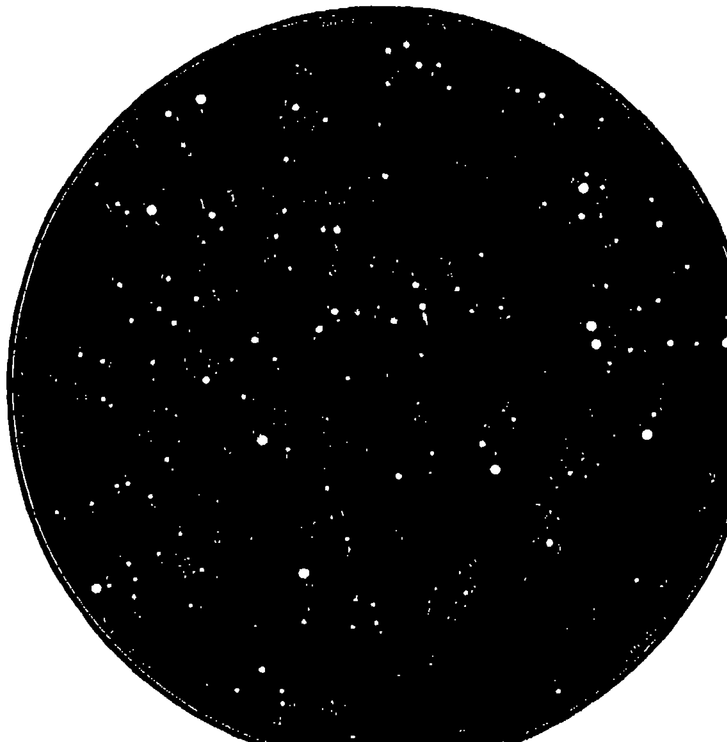
Brightnesses and Distances

Now a dozen and more variable stars of the Cepheid class lie near enough to us to be visible to the naked eye For these we have good proper motions, and we can use the drift caused by the sun s motion to find their distance It thus appears that such a star, with a period of eight days is (on the average) about a thousand times as bright as the sun—whence it follows that the faintest with periods of half a day or less, exceed the sun a hundred fold in brightness, and the brightest with periods of a hundred days run up to the enormous figure of 50 000 times the sun s light Such huge objects however, are very rare Having established this, it becomes a straightforward matter to calculate the distance of any variable star of the Cepheid type or of any cluster or group of stars in which such variables can be found

It was in this way that Shapley reached his epoch making conclusions regarding the globular clusters—the nearest of which is 20 000 light years away and the remotest more than 200 000 The distances of the Magellanic Clouds, too can be found Shapley estimates them at 80,000 light-years for the Small Cloud, and 110,000 for the Large, making the diameter of the first 5000 light years and of the second 14,000

Enormous as these distances are, they are quite surpassed by that of a more recently studied object This is a very faint cloud of light in the constellation Sagittarius (in 19h 40 m R A. and -15 degrees declination) which is known as N G C 6822 since it bears that number in the "New General Catalog of nebulae and clusters Discovered by Barnard forty years ago this object has been recently photographed by Perrine at Cordoba and Hubble at Mount Wilson, who agree in describing it as similar to the Magellanic Clouds, though much smaller and fainter It is only ten minutes of arc long by five wide (as against 3½ degrees for the Small Magellanic Cloud and 7 degrees for the Large), and its brightest stars are of the magnitude 18 5, so that only long-exposure photographs with the most powerful instruments will show them

Diffuse nebulae are found among the stars of the Magellanic Clouds and also in the new object, though in the latter case they are only of about one-eighth the apparent size of those in the former If we assume that the nebulae are really of the same size in the two cases, we conclude that N G C 6822 is eight times as far off as the Clouds If we assume that as a whole it is the same size as the Clouds, we arrive at distances 12 or 15 times as great Finally if we assume that the brightest stars in the new object are really similar to the brightest in the Clouds we conclude that its distance is ten times as great. Combining these estimates (which are due to Dr Shapley), we may conclude with some confidence that the distance of N G C 6822 is of the order of one million light years. This puts it far beyond all other known objects, and probably clean outside our galactic system, and adds another, and very striking, chapter to our advancing knowledge of the depths of space



At 11 o clock Apr 7
At 10½ o clock: Apr 14
At 10 o clock: Apr 22
At 9½ o clock April 30
At 9 o clock: May 7
At 8½ o clock: May 15
At 8 o clock May 23

The hours given are in Eastern Standard Time. When local summer time is in effect, they *must be made one hour later: 12 o clock on April 7 etc*

NIGHT SKY: APRIL AND MAY

The Heavens

The winter constellations are now lost to view, except where

"Starry Gemini hangs like glorious crowns
Over Orion s grave low down in the west."

(Tennyson was always accurate in his astronomy.) To the northwest we find Auriga, and on the north Cassiopeia and Cepheus—all low down Lyra has come up in the northeast, and Cygnus is rising Hercules is in the east, with Ophiuchus below, and Scorpio rising in the southeast

Four great constellations are grouped around the pole Ursa Major to the north (with Ursa Minor and Draco below), Boötes to the east, Leo to the west Virgo to the south. Below the last two is Hydra, stretching from the south nearly to the west, with Corvus above, and Centaurus below—fully visible only in the tropics.

The Planets

Mercury is an evening star all this month, and is at his greatest eastern elongation on the 16th, 20 degrees from the sun At this time he is excellently placed for observation, being nine degrees north of the sun, and remaining above the horizon until 8 20 P M Moreover, he is then in Aries, remote from any bright stars, and looks almost as bright as Capella, so that there should be no mistaking him He will be conspicuous in the twilight for a week before and after the date named, but hard to see at the beginning and end of the month

Venus is also an evening star, and also in elongation on the 21st, nearly 46 degrees from the sun. No other planet is ever as conspicuous as she is at times like this, which recur every eight years, when she is simultaneously far away from the sun and as far north of him as she ever gets She is 26 degrees north of the celestial equator and remains in sight until 10 40 P M Being a hundred times as bright as a first magnitude star like Aldebaran and ten times as bright as Sirius, she attracts even the most casual glance Her light, falling through a window on a white wall or screen, casts a distinct shadow and she is easy to see in broad daylight, if one only knows where to look for her On the 7th and 8th the moon may serve as a guide, but, being more than 8 degrees south of the planet, as a rather poor one.

Mars is in western quadrature on the 13th, and is already as bright as Procyon, but he is so far south, in Sagittarius, that he does not rise until 1 30 A. M

Jupiter is in Ophiuchus, rising at 11 P M and crossing the meridian at 8 40 A. M in the middle of the month.

Saturn is in Virgo, and comes to opposition on the 19th His rings appear more widely open than for some years past, and he is therefore brighter, equaling Procyon

Uranus is in Pisces, and comes to the meridian between 3 and 4 A M Neptune is in Leo, and visible all the evening

The moon is new at 2 A. M. on the 4th, in her first quarter at 6 A. M on the 12th, full at 9 A. M on the 19th, and in her last quarter at 11 P M on the 25th She is nearest the earth on the 20th, and farthest away on the 8th During the month she passes near Uranus on the 2nd, Mercury on the 5th, Venus on the 8th Neptune on the 14th, Saturn on the 19th, Jupiter on the 22nd, Mars on the 25th, and Uranus again on the 29th.

Modern Ideas in Old Mexico

DR. J WALTER FEWKES of the Bureau of American Ethnology at Washington, hardy perennial explorer of the regions of the New World that give evidences of the antiquity of western civilizations, has found some pictures on pottery from New Mexico which present a distinct comedy aspect. These paintings would indicate that the gentle art of gambling with dice and keeping track of the state of the game with counters corresponding rather well to the poker chip of modern life, was well known in the prehistoric south west. Another aspect of modern civilization in which we appear to have been forestalled by these Indian races, if the evidence of the potter's brush is to be believed, is the dancing chorus girl of scanty attire.

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.

Pertaining to Aeronautics

FLYING MACHINE—Having propulsion means which may be utilized for driving or lifting an airplane or aeronautical apparatus. Patent 1476162. J. A. Lehnert, Howard, S. D.

Pertaining to Apparel

COLLAR STUD SUPPORT—The object of which is to prevent the stud pressing upon the thyroid gland. Patent 1473549. A. Goldknopf, 200 W. 111th St., New York, N. Y.

COLLAR FASTENING DEVICE—For associating a collar with the rear portion of a shirt neckband. Patent 1478460. G. L. Brisbin, Brisbin, Mich.

GARTER CONSTRUCTION—Whereby the hosiery to be gripped by the clasp, can be easily attached or detached therefrom. Patent 1475868. G. W. Peterson and J. P. Ycnetis, address G. W. Peterson, c/o Postmaster, N. Y. City, U. S. S. "Prometheus."

HEAD AND SOCKET FASTENER—For cloth ing, so constructed that it will remain closed until opened by the wearer. Patent 1475805. Rosa M. Peters, c/o Peters Bros. Rubber Co., 4109 Park Ave., New York, N. Y.

Chemical Processes

PROCESS FOR THE SYNTHETIC PRODUCTION OF ALKALI—Metal cyanides. Patent 1472403. F. Von Bichowsky, 1412 San Fernando Blvd., Glendale, Calif.

Electrical Devices

ELECTRIC POWER DEVICE—In which a current is generated without any appreciable loss of power or lighting circuit. Patent 1471957. W. C. Hahne, 712 S. Charles St., Elgin, Ill.

AUXILIARY MOUTHPIECE FOR TELEPHONES—Whereby all sound waves of the voice are directed into the mouthpiece and external sounds prevented from entering. Patent 1474100. O. W. Aagaard, 5144 N. Albany Ave., Chicago, Ill.

THERMOSTATIC SWITCH FOR FLATIRONS—Capable of being associated with an electric iron of standard construction. Patent 1474588. R. D. Hetrick, Box 226, Indiana, Pa.

METHOD AND APPARATUS FOR CONTROLLING SUGAR CENTRIFUGALS—And similar devices which are electrically operated. Patent 1475121. F. H. Jones, Tuinucu, Cuba.

CIRCUIT CONTROLLER—To be used particularly in connection with refrigerating apparatus. Patent 1475313. A. G. Newhard, 617 Hanover Ave., Allentown, Pa.

TROLLEY—For overhead electric wires, which increases the area of contact between wheel and wire. Patent 1478311. J. T. Welsh, Westfield, N. J.

FIXTURE SUPPORT—Which will not only support an electric lamp but a canopy as well. Patent 1478595. F. E. Wooley, Box 112, Manasquan, N. J.

CONTROLLING AND REGULATING SYSTEM FOR DYNAMOS—Which may be used as indicating lamps mounted in guard casings in the vicinity of persons supervising the system. Patent 1475880. W. J. Rickets, 32 Torrens Rd., Brixton Hill, S. W. No. 2, London, England.

6.—WHAT IS INFRINGEMENT OF A PATENT?

THE invention covered by a patent is defined by the claim or claims thereof. In order to infringe a patent, the alleged infringing process or structure must fall within the scope of at least one of the claims, that is, such claim must define the infringement. Furthermore the latter must embody all of the elements or features of the claim arranged and organized as specified therein. If a single such element or feature is wanting there is no infringement. Any one who without ownership or license makes or uses or sells an infringing article violates the patent right. Even making an infringing device for one's personal use only, constitutes an infringement. On the other hand, making an infringing article merely for the purposes of experimentation or improvement is not necessarily an infringement. Infringement of a patent is always a question of fact. Frequently infringement cannot be determined on its face and the claim must be interpreted in the light of the prior patent and other art as to whether or not it is to be construed broadly or otherwise. Frequently a patent which on its face appears to be infringed, when construed so that its place in the art can be determined, is found not to be infringed because it must necessarily be given a narrow construction. In order to infringe a patent it is not necessary to infringe every claim thereof. If one claim only is infringed, the right is violated even if there are other claims which are not infringed. Infringement is often a question of equivalency, that is, the alleged infringing structure may not comprise the exact elements or features of the claim, but if it includes certain structural elements which are the mechanical equivalent of those defined in the claim, the latter is infringed.

ELECTRIC SOLDERING IRON—In which the heat transmitted to the soldering point may be regulated. Patent 1478310. F. Young, c/o Adroit Tool Co., 14 Front St., New York, N. Y.

IMPLEMENT FOR WRITING—In the form of a pencil having a self-contained electrically heated scoring point. Patent 1455842. W. F. Kelly, 915 W. Front St., Greenwood, Miss. (See Fig. 1.)

Of Interest to Farmers

WEEDER—In which the weight of the machine enables the weeder bar to uproot the weeds. Patent 1472749. G. W. Fairbourn, R. D. No. 2, Box 30, Salt Lake City, Utah.

PLOW—Especially adapted for cotton cultivation. Patent 1472728. J. E. McNeil, Raleigh, Tenn.

HOG TROUGH—That may be secured against movement or may be shifted from place to place for feeding hogs. Patent 1478100. M. J. Hoesch, Randolph, Neb.

ATTACHMENT FOR DISK HARROWS—Which will gage the depth of the cut made by the disks and may be attached to harrows of ordinary construction. Patent 1475312. T. D. Moran, Dillon, Mont.

DITCH DIGGER—In which the cutting depth may be varied and the dirt conveyed to either side of the ditch. Patent 1475550. A. Naylor, c/o M. Purdin, 406 Medford Bldg., Medford, Oregon.

IRRIGATION DITCHER—Which is adjustable for varying depth and width of cut and in which the cutting edges are self sharpened. Patent 1177033. R. C. Chattin, Mountain Home, Idaho.

CONVERTIBLE DRYING KILN AND CRIB—Constructed entirely of cement and steel for receiving and storing corn or other grain. Patent 1477082. C. W. Atherton, 629 So. Walter St., Albuquerque, N. Mex. (See Fig. 2.)

CHURN—Adapted to be manually operated, or operated by mechanical power. Patent 1478748. J. A. Lawrence, Lindsay, Okla.

PRESS—Which automatically feeds material into a baling chamber for moving bales. Patent 1478450. C. D. Melton, Eustace, Texas.

CATTLE GUARD—Formed of spaced supporting members placed over a ditch which will tend to obstruct the passing of cattle. Patent 1478027. W. A. Tomlinson, 346 W. Monroe St., Phoenix, Ariz.

Of General Interest

ENVELOPE—Capable of being used for sending and returning mail matter. Patent 1470335. N. Sternheimer, 3001 Lester St., Richmond, Va.

SAFETY RAZOR—The parts of which may be readily cleaned without resorting to disassembling. Patent 1469715. A. S. Breakey and C. F. Pietsch, c/o A. S. Breakey, c/o Frank Seaman, 470 4th Ave., New York, N. Y.

COPYHOLDER—Especially adapted for typists use for holding copy in place. Patent 1469749. A. N. Woodruff, Box 1907, Washington, D. C.

WATCH FILLER RING—For utilizing a small watch movement in a large case. Patent 1469735. A. L. Stearns and A. W. Hofmann, c/o Roy Watch Case Co., 15 Maiden Lane, New York, N. Y.

PLUG FOR ICE AND HOT WATER BAGS—Which may be quickly operated to seal the mouth of the bag. Patent 1471103. A. Connor, c/o Universal Hospital Supply Co., 500 N. Dearborn St., Chicago, Ill.

LOCKING DEVICE—For coupling tubular members together in alinement and normally preventing disconnection. Patent 1471077. C. Vogt, 1859 Washburn Ave., Chicago, Ill.

TRENCH MORTAR—Which can be used individually or in connection with others to form a battery. Patent 1471063. F. Rognlie, c/o G. H. Burgenhagen, Weinrebe Bldg., Minot, N. D.

INDIVIDUAL PIE CONTAINER—Which is leak proof and in which a piece of pie may be readily carried. Patent 1470763. A. J. Richards, 4515 Emerald Ave., Chicago, Ill.

METHOD OF DECORATING LEATHER OR SIMILAR MATERIAL—Whereby a design may be easily applied with a background of any color. Patent 1470535. F. A. Kolb, 65 13th Ave., Newark, N. J.

TUBE SQUEEZER—Especially intended for squeezing tubes containing toothpaste. Patent 1470534. S. J. Kelper, 317 E. 83d St., New York, N. Y.

MEASURING TRIANGLE—Whereby the circumference of a circle can be obtained by the reading of a scale. Patent 1470530. C. Hohmann, 755 Peterson Ave., Jersey City, N. J.

POCKET FILE CASE—Designed to be carried in the pocket for housing a card index system. Patent 1470549. H. Steinmeyer, 1446 Hurlbut Ave., Detroit, Mich.

ARTIFICIAL PLANT—Which may be used for outdoor decoration maintaining its shape regardless of the weather. Patent 1470516. Jennie M. Weyandt and Mary Tafarella, 1761 Avalon Road, Cleveland, Ohio.

CONTAINER HANDLE—Adapted to be applied to containers holding shoe polish or the like. Patent 1470536. F. A. Lange, Claresholm, Alberta, Canada.

RECEIVER SUPPORT FOR SOUND AMPLIFIERS—Which may be easily attached to the ordinary type of phonograph horn. Patent 1469941. C. W. Kuen, 1520 Edgewater Ave., Chicago, Ill.

CLOTHESPIN—Which will grip the clothes and suspend them from the line without bringing them into contact. Patent 1478353. P. C. Partenio, 139 Pearl St., Brooklyn, N. Y. (See Fig. 3.)

TOY ANIMAL AND METHOD OF MAKING SAME—In such manner that it may be washed with soap and water without injury. Patent 1478348. L. Myers, 108 E. Fulton St., Gloversville, N. Y. (See Fig. 4.)

CONDENSING LENS—By means of which the ultra violet rays in light generated by high power lamps may be neutralized. Patent 1470512. M. J. Tromba, c/o Paramount Lens Co., 10 Clifford St., Providence, R. I.

NAIL BUFFER—With means for removably associating the chamois with the buffer proper. Patent 1470857. J. Lupo, c/o Columbia Manicure Mfg. Co., 3606 Park Ave., Bronx, N. Y.

POCKET MEDICINE RECEPTACLE—Especially adapted for carrying a small number of doses of medicine. Patent 1470547. H.

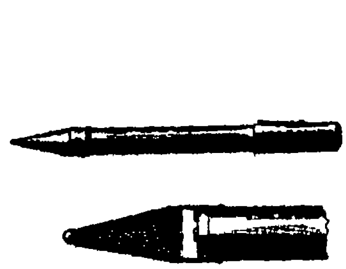


Fig. 1. Scoring pencil with self-contained electrically heated point, invented by W. F. Kelly

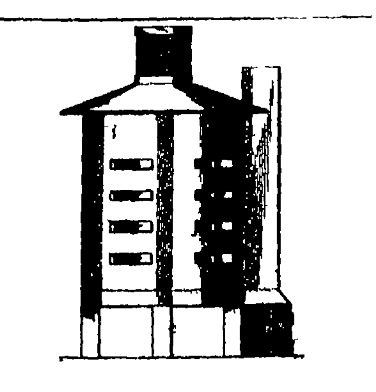


Fig. 2. G. W. Atherton's drying kiln and crib of cement and steel, for receiving and storing grain

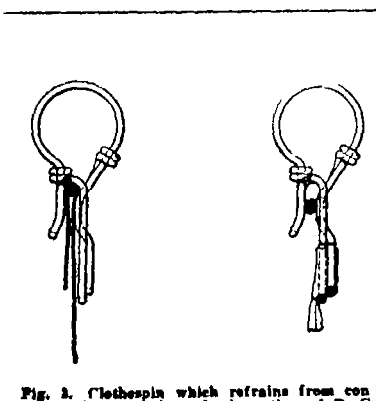


Fig. 3. Clothespin which refrains from contact with the clothes, the invention of P. C. Partenio

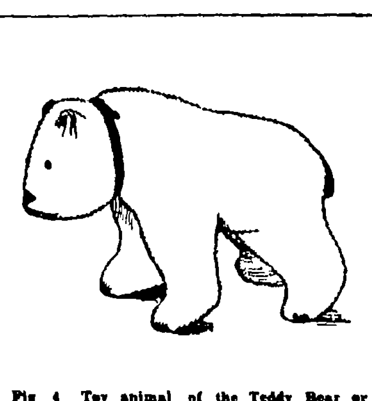


Fig. 4. Toy animal of the Teddy Bear or other persuasion which may be washed with soap and water as patented by L. Myers

A Schilling, 10454 114th St., Richmond Hill L I, N Y

SAFETY ENVELOPE—Which cannot be opened without being mutilated Patent 1470715 G Doutney, 567 Halsey St., Brooklyn, N Y

SAFETY PORTABLE SCAFFOLD—For use by painters carpenters and others doing work requiring a platform Patent 1471304 J F Young 1108 E 53d St., Los Angeles, Cal

METHOD OF MAKING ARTIFICIAL FLOWERS—Which shall be an exact reproduction of the natural flower Patent 1470909 M B Greene, The Homestead, Yarmouthport, Mass

SIFTER TOP FOR CONTAINERS—More particularly for powder cans or the like Patent 1471298 L A Wegenaar, 320 83d St., Brooklyn N Y

FISH LURE—Designed to attract so called game fish, and to effect economy in the use of bait Patent 1470842 H T Hyams, 1st State Bank Bldg DeKalb, Texas

TOILET ARTICLE—Which affords facilities for removably holding a lipstick or the like Patent 1470094 J B Mason, Jr, 308 Stahlman Bldg, Nashville, Tenn

HAIRPIN—Which automatically locks it self in the hair Patent 1471612 F V Kosatka and E. Stepkal, c/o F V Kosatka, 2241 S 59th St, Cicero, Ill

FRUIT BASKET—With movable handle so that a number of baskets may be nested for shipment Patent 1471053 P J F Gallagher, Box 446, Marlboro, N Y

METHOD AND APPARATUS FOR THE REDUCTION OF IMPURITIES CONTAMINATING MOLTEN METALS—By filtering the molten metal through molten slag and cinders. Patent 1472006 L. Jones, 928 Wheeling Ave, Muncie, Ind

HEAT AND COLD INSULATING RECEPTACLE AND APPARATUS FOR SUPPORTING AND FINISHING THE SAME—In which a vacuum chamber is sealed in a novel manner Patent 1472019 T E Hitch, 813 Sycamore Ave, Cincinnati, Ohio

MATCH CASE—For book matches in the cover is provided a slot which registers with the scratching surface Patent 1471012 J Oppenheim, c/o Dasco Import Co, 384 Broadway, New York

CATCH BASIN—For sewer traps which will prevent solids from entering the sewer Patent 1471810 J H Bauschard, 1025 Holland St Erie Pa

FLY HOOK—With means for effecting engagement with a fish line Patent 1471959 P F Halferty, 314 E. Pike St, Seattle, Wash

FILING SYSTEM—In which any card may be instantly removed Patent 1472020 W H Holmes, Central Blvd, Mount Vernon, N Y

COOKING UTENSIL—For frying oysters or French fried potatoes Patent 1472205 A H Brunner, Cottage Cafe, Carbondale Ill

ARTICLE SLICING DEVICE—Which affords facilities for slicing bread to a uniform thickness Patent 14722219 O N Hoffman 1651 So State St., Syracuse, N Y

OIL OR GAS WELL CASING—For sealing the annular space around the tubing Patent 1472555 E V Crowell, Box 1479, Station C, Los Angeles, Calif

ADJUSTABLE DOORSTEP—Which will effect the stopping of the door at predetermined points. Patent 1472531 G T Morris, 1130 So Higgins Ave Missoula, Mont.

HOSE REEL—In which the nozzle is carried by the device and is movable to any point within the length of the hose Patent 1472747 I A Crocker, 508 So Elm St. Kankakee, Ill

TESTING AND SAFETY DEVICE FOR TRAPS—Permitting a limited movement of the traps toward its closed position for setting the trigger Patent 1472666. T L Munroe 219 New Boston Rd, Fall River, Mass

AUTOMATIC CONTROL FOR WINDOW SHADES—Which causes the shade to be lowered in rainy weather Patent 1472703 R Walser, 122 Franklin St. Union Hill, N J

CONCRETE BLOCK CONSTRUCTION—Which permits of firmly locking the blocks together in a simple and quick manner Patent 1472680 M Roffino, 84 Charles St, New York, N Y

DENTIPHONE—For more clearly hearing music recorded by a talking machine. Patent 1472214 J W Gobbe, Anderson, Tenn

FOLDING CONTAINER—Adapted to conveniently accommodate both hair nets and hair pins. Patent 1472755 A L. Hawes, c/o Empire Notion Co, 72 Madison Ave., New York, N Y

BURGLAR ALARM—Adapted for use in connection with containers such as safes. Patent 1472750 J F and F C Gorman, 1339 University Ave., Bronx, N Y

CLOTHESLINE BRACKET—To be swung exteriorly of a window when in use Patent 1472705 R. Wardhaugh, c/o Mrs Murry, 2441 Coney Is Ave, Brooklyn, N Y

CASTING ROD—For automatically shooting a projectile carrying a line, hook and bait to a desired distance Patent 1473507 C A Obermaier, Box 442, Lompoc Calif

CLOSURE FOR BOTTLE—Which will securely close the bottle or vial, yet present an attractive appearance Patent 1473540 C L Bernardo, c/o Floral Products Co, 301 W 125th St., New York, N Y

FOLDING CROSS—Comprising a hollow base acting as a container, the whole making a small package Patent 1473530 H T Walrow, 448 W 35th St., New York, N Y.

GOLF PUTTING BOX—By means of which persons may train themselves to put accurately both for direction and force Patent 1473051. A B Scott, Fairmont, W. Va.

FILM DRYING APPARATUS—Whereby material such as motion picture film can be efficiently dried in a short time Patent 1473542 G L Chanier and A L Adatte, c/o Pathe Exchange, 1 Congress St, Jersey City, N J

ROLLER CURTAIN GRINDING AND LOCKING DEVICE—For preventing any flapping of porch curtains or the like Patent 1473517 W M Richards, 222 E 59th St., Chicago, Ill

ATMOSPHERIC COMPOUND FOR DIVERS USE—By means of which the period of work under water can be increased Patent 1473337 C J Cook, 33 B Street, N W, Washington, D C

COUPLING—For attaching a hose or the like to faucets of varying sizes. Patent 1473537 H Bailey, 2307 Morris Ave, New York, N Y

CHERRY AND CONFECTION CENTER DEPOSITING APPARATUS—By means of which a number of operators may be dispensed with in the laying of cherries nuts, etc Patent 1473458 T Bosshard, St. Albans, Queens Co, N Y

SOUND CLARIFIER—For the projection of sound waves such as occur in talking machines Patent 1473560 C W Johnson, Box 59 Genl P O New York, N Y

INDICATOR—Which is capable of wide use, but particularly for displaying prices at gasoline stations. Patent 1473472 J F Dodd, 67 Lincoln Ave., Delaware, Ohio

SHEET OF MUSIC—Which may be read by persons unfamiliar with the theory and technique of music. Patent 1473495 F R. Miller, 2020A Jackson St., San Francisco, Calif

DOOR AND FRAME CONSTRUCTION—For the oven of a stove, which will swing automatically to closed or open position Patent 1473978 E. Schmalo, c/o Belleville Stove & Range Co, Belleville, Ill

OILER—By means of which oil cups at an elevated point may be conveniently lubricated Patent 1473852 L S Harrell, 633 Middle St., Baton Rouge, La

CALCULATOR—Which will enable the user to ascertain the board feet in a given number of pieces of lumber Patent 1473948. A L Beck, c/o Orlando Novelty Works, Orlando, Fla

WATER CLOSET VALVE—By which a portion, or the entire contents of a tank may be drained at will Patent 1474288 H A. Rath, 141 Jefferson Ave, Elizabeth N J

HUMIDOR—For preserving the aroma of cigars in an ordinary cigar box Patent 1474254. J. Gerstle, 515 W 157th St. Aptm 7, New York, N Y

ALARM CLOCK RELEASE FOR PHONOGRAPHS—Which when the alarm goes off, will permit the phonograph to play and wake the sleeper Patent 1474240 L. Crane, c/o Fine 1670 Boston Rd, Bronx, N Y

FRUIT DRIER—Intended for domestic use over an ordinary cook stove or suitable heater Patent 1474687 J B Raby Jr, R. 6, Box 42, York, Pa.

FOUNTAIN BRUSH—Such as are used for dispensing paste Patent 1475116. E H. Harvey, 331 Market St., Lewisburg, Pa.

VAPOR BATH—Including a rest supported in a bath tub and a canopy disposed over the same. Patent 1475091. J Thomas, Aberdeen, Wash.

SUPPORT FOR ALARM CLOCKS—Which lends to the clock an ornamental appearance. Patent 1475137 J Oppenheim, 404 W 145th St., New York, N Y

HAIR NET CONTAINER—In which a hair net may be packed without being crushed or wrinkled Patent 1475130 H. Mauer, c/o Seidner & Hitzigrath, 1140 Broadway, New York, N Y

LADY'S SAFETY POCKETBOOK—With means for preventing the opening of the same without detection Patent 1475132 T L Monaghan, 19 E 101st St., New York, N Y

FLYTRAP—Which automatically traps and collects the flies into a suitable receptacle Patent 1475095 H Van Hoes, Hotel Manse, Trenton, N J

SHAVING MUG—With means for maintaining the contents in a heated condition Patent 1475905 E D Van Hersen, Three Forks, Mont

LIFEBOAT RELEASE—Which may be operated from the boat with which the same is associated Patent 1475617 S E. Allbin, c/o Mayer Life Boat Co, 411 Haller Bldg, Seattle, Wash

FLUSH TANK—That does away with floating lift valves, wires and rubber balls Patent 1475841 D McNeill, Huntington, W Va.

WINDOW SCAFFOLD—That may be set up and collapsed quickly and adjusted to different size windows. Patent 1475780 C R. Basini, 546 Roosevelt Ave, Cateret, N J

IMPLEMENT FOR CLEANING TEETH—Formed by utilizing the handle of the brush as a holder for a dental floss or gauze. Patent 1475789 T A Buckley, 580 Nostrand Ave, Brooklyn, N Y

HOUSE NUMBER AND STEP ILLUMINATOR—Which effectually displays the number and illuminates the steps after dark. Patent 1475866. C P Peterson, 1725 E. 4th St, Brooklyn, N Y

SANITARY BELT—Comprising a girdle with detachable tabs, and means for removing the tabs and the napkin Patent 1475895 J Stein c/o Climax Rubber Co, 520 Broadway, New York, N Y

SECURING DEVICE—Designed for fastening a plurality of pieces of leather metal or other material Patent 1475827 L J Hogarty, 5 Beekman St., New York N Y

VEGETABLE GRATER—Which may be mounted on a suitable receptacle, for receiving the grated vegetable Patent 1475839 L Leitman, P O Box 206, Mount Vernon N Y

REMINDER SIGNAL—For imparting to the owner recollection of an intended action Patent 1475780 H L Beach, Disbursing Office, U S Naval Station, Carile, Philippines.

METHOD OF PRESERVING EGGS—Which in no way effects the edibility, or requires special conditions for storage Patent 1475804 R. Du Bois and H I Jones c/o Dept of Chemistry, Okla, A & M College, Stillwater, Okla

UMBRELLA STAND—So constructed as to provide a separate compartment for each umbrella Patent 1476599 G De Witt, 5 John St., Gloversville, N Y

INDEX FILE—Particularly adapted for use, such as would be suitable for salesmen, etc Patent 1476662 R J Weinacht, 306 Amsterdam Ave, New York, N Y

CIGARETTE APPLIANCE—For manually rolling cigarettes, and also forming a receptacle for the tobacco and papers. Patent 1476652 M. M Shore, 631 E. 138th St., New York, N Y

EDUCATIONAL APPARATUS—Which will materially assist students to visualize the geographic location of places Patent 1476,671. J S Crate 609 White Oak St., Houston, Texas.

KEY HOLDER—Which is provided with a plate to which a plurality of key holding elements are attached Patent 1476642. D I. Reiter, 100 5th Ave., New York, N Y

POURING SPOUT—For pouring milk or other liquids from tin or other cans Patent 1475988. V Dien, c/o Lewis Oil Co, R. R. No 2, Breckenridge, Texas

MOPS—Having a cleaning element which may be detached for renewal, or may be adjusted Patent 1476318. W H Zachry, c/o Atlanta Variety Works, St Charles, Lakeview and Greenwood Ave, Atlanta, Ga.

MOP—With means for adjustment for preventing the free swinging of the head Patent 1476317 W H. Zachry, c/o Atlanta Variety Works, St. Charles, Lakeview and Greenwood Ave., Atlanta, Ga.

METHOD OF RESTORING OR REJUVENATING BALE-TIE BANDS—By annealing and cold rolling the pieces, to elongate them while maintaining their width. Patent 1476346. R. Margolius, Box 73 West End Annex, Richmond, Va.

DENTAL THREAD HOLDER — Especially adapted for use in cleaning one's teeth with dental floss. Patent 1475986. C C Cooke, Morton's Gap, Ky

BRACKET FOR MOUNTING PULLEYS—Upon which a pulley may be rotatably carried, and shifted for tightening the cable Patent 1477229 G R. Northrup, c/o W H. Hayes, 1st Natl. Bank Bldg, Laramie, Wyo

SMOKING PIPE—In which the smoke is cooled and purified before reaching the smoker's mouth Patent 1477029 A G Blomster, Amidon, N D

GUN SIGHT—By means of which the proper elevation of the muzzle may be found with both eyes open. Patent 1476894 E. E. Gregory, 425 5th Ave., New York, N Y

PRINTER'S CHASE—By means of which a type form can be quickly and accurately centered. Patent 1477046. A. C. Evans, 331 W Gold St, Butte, Mont.

SELF-SERVICE STORE—In which customers can readily select and serve themselves with the various commodities. Patent 1477492. M R. Hutchison, c/o Munn, Anderson & Munn, Woolworth Bldg, New York, N Y

HORSESHOE — Of combined rubber and metal, the rubber being anchored by key members. Patent 1477007 F C Robertson and P P Rooney, c/o F J Nelson, Hornell, N Y

SEWER BASIN HEAD—Including a main body section and a curb section which may be detached Patent 1477435 J J Fagan, Coles and 14th St, Jersey City, N J

TOBACCO CONTAINER—For the reception of leaf tobacco, the entire contents of which may be exposed without removing the same. Patent 1477105 T R Brumfield, 402 No Union St, Danville, Va

INSECTPROOF PORTAL CONSTRUCTION—By means of which insects are precluded from passing from the outside to the inside of a building Patent 1477497 M. R. Hutchison, c/o Munn, Anderson & Munn, Woolworth Bldg New York, N Y

OIL WELL PACKER—For preventing any fluid detrimental to the well from flowing through the casing Patent 1476727 J S Quigg c/o Star Machine Works, Box 25, Dewey, Okla

PRINTING FRAME—For use by photographers, adapted for printing by artificial or natural light. Patent 1478217 D W Gray, 131 E 5th St., Los Angeles, Cal

BELTING—Which will not stretch, unravel or pull out from the splicing Patent 1477707 W S Langford, c/o Mt. Vernon Belting Co, Baltimore, Md.

PACKING GUIDE FOR FRUIT AND VEGETABLE CONTAINERS—For use where it is essential that jostling is prevented in transit. Patent 1477542 G L Comloasy, 408 Produce Exchange Bldg, Toledo, Ohio

SANITARY CUSPIDOR—For use in households, hospitals, and public places Patent 1477005 S Rianda, R. R. No 5, Box 16B, Watsonville, Cal

BELT ATTACHMENT—Providing a simple means whereby a pencil may be carried on one's belt. Patent 1477551 C. A. Eva, 609 Henderson St., Austin, Texas.

INDICATOR FOR CAMERAS—Which includes mechanism for preventing a double exposure Patent 1478318 E. M Woodworth, 346 So Goodman St., Rochester, N Y

UNIVERSAL JOINT—Constructed as to permit a ready uncoupling when moved to abnormal position Patent 1478324. A Dina, 161 Jefferson St, Woodbridge, N J

VENTILATOR—Especially designed to prevent the formation of steam on show windows. Patent 1478312 A. Wenger, 432 Broadway, Bayonne, N J

IRONING TABLE—Which may be folded into compact form when not in use. Patent 1478051 E. L Golden, c/o Am. Wooden ware Co., Manistee, Mich.

TAP DEVICE FOR WOODEN BARRELS—Particularly applicable to barrels containing malt syrup, glucose, vegetable cooking oils, etc. Patent 1478918. W Rupp, c/o Universal Rug & Carpet Cleaning Co., 449 Central Ave., Newark, N J

CLEANING CLOTH—Which can be effectively attached to either hand, without losing the area of the cloth Patent 1478914. J. Bitzenthaler, 73 Franklin St., New York, N. Y

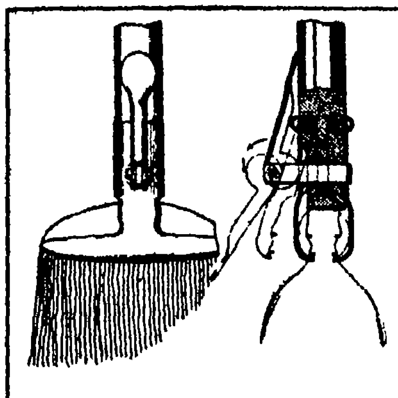


Fig 5 Easily removable, metal jawed mop handle, the invention of W H Jayne

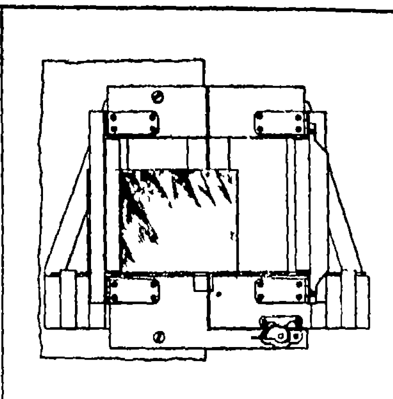


Fig 6. Glass-cutting frame for use in horizontal or vertical position designed by M. L. E. J and A. L. Shaw

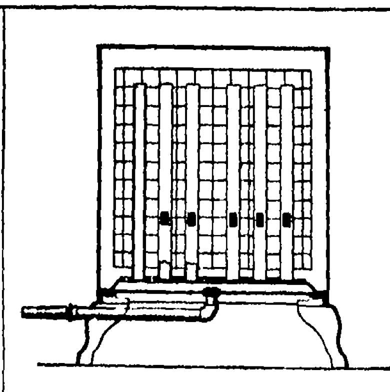


Fig 7 J P Lane's gas stove on which the flame is controlled through openings in the combustion tubes

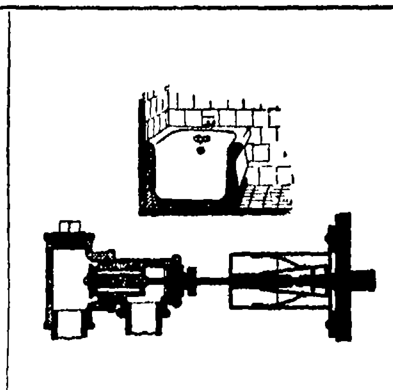


Fig 8 Mechanism for the operation of fluid valves without the use of projecting heads, developed by A. G Bertram

RUDDER—For use in the navigation of screw propelled vessels. Patent 1478928 J J Toner, 280 W 142d St., New York, N Y

PROCESS FOR MAKING MEAT CASINGS—Which will not contain any substance injurious to the health or develop any chemical actions Patent 1478068. C S Lenz and H M Cohen, c/o Jupp, 600 W 139th St., New York, N Y

WINDOW CONSTRUCTION—By means of which a person may clean both sides of a window from within the room Patent 1478922 H. J Smith, 906 E 35th St., Brooklyn, N Y

MOP HEAD—Formed from metal jaws, attached to rotate from the mop handle Patent 1478339 W H Jayne, 414 E 23d St., New York N Y (See Fig 5)

GLASS CUTTING FRAME—Which may be used upon a table or in a vertical position Patent 1479748. M L, E. J and A L Shaw, Corinne, Utah (See Fig 6)

BELT—For carrying bait, leaders a knife, and other necessary articles for use in fishing Patent 1478497 R. W Welch, Kelso, Wash.

EGG BOILER—Which may be set to time eggs and raise them when boiled Patent 1478939 R. J Cavilla, 1124 E 170th St., Bronx, N Y

RAPID TOWEL HANGER—With spring jaws for holding the towel corner Patent 1478911 F Philippe, Sr, Box 3, South Charleston W Va.

EXPOSURE METER — For indicating the proper duration of photographic exposures Patent 1478956. E Harrold, Lotonia, Ohio

PROCESS OF PREPARING DRY AND SOLUBLE EXTRACT OF ROASTED COFFEE—Which contains without appreciable loss the total soluble principals of the coffee Patent 1478940 A Chalas, 14 Rue Angelique Verien, Neuilly, France.

UNIT DRIER—For drying materials which have been subjected to a coating operation, such as wall paper Patent 1478938 L B Case, c/o Standard Wall Paper Co, Hudson Falls, N Y

Hardware and Tools

RAKE—In which the clearing of the tines by hand is done away with Patent 1471964 R. E Leas, Luverne, Minn

REHEATING DEVICE FOR SOLDERING IRONS—Which can be safely moved in any direction, and which includes a combustion chamber Patent 1472720 J E Malivert, 11 Rue du Telegraphe, Paris, France

ICE CREAM DIPPER—Requiring but slight muscular exertion in its operation for dispensing portions of the cream Patent 1472533. W R. Ripley Sherman, Calif.

METAL WORKING TOOL—That will ream two or more holes in accurate alinement. Patent 1473245 F P Miller, c/o McCrosky Tool Corp., Meadville, Pa.

RIVET—Having a split shank, for use in connecting thin metal plates. Patent 1478187 N Zierten, 64 Adams St., Albany, Calif.

WEIGHTED SCRAPER—So constructed as to be particularly useful in cleaning heavily coated surfaces. Patent 1478546. W Eiermann, 1917 Fulton St., Brooklyn, N Y

REAMER—Which is so constructed that the cutting edge is maintained for a long period, and a smooth hole produced. Patent 1475311. F. P. Miller, c/o McCrosky Tool Co., Meadville, Pa.

LOCKING DEVICE FOR PLUGS—Designed for use with grease plugs and oil cup covers Patent 1474239 G S Collins, 676 N Main St. Meadville, Pa

OIL WELL TOOL—For removing broken pieces of steel or the like from the bottom of a well Patent 1475456. W P Stampfli Box 784, Healdton, Okla

WRENCH—Adapted for use as a twin wrench in connecting sectional drill stems used in wells Patent 1476341 G F and F L Le Bus c/o Le Bus Rotary Tool Works, Electra Texas

LATHE—Especially adapted for use in refacing the valves of internal combustion engines Patent 1477102 N F Brasacchio, c/o A F Indrieri Atty Gary Ind

TOOL HOLDER—With means for adjusting the cutting tool on a lathe Patent 1478067 S A Lee, Hudson Falls N Y

DRILL—Which is especially adapted for cutting metal The inventor has been granted two patents of a similar nature Patents 1478623 and 1478624 F H Valiton, c/o Branscombe & O Neill Deer Lodge Mont

Heating and Lighting

COLLAPSIBLE STOVE — Especially adapted for use in camping occupying but small space when packed for transportation Patent 1473523 N H Smith c/o Smith's Garage Spring Valley Ill

OIL BURNER—Which is adapted to heat a furnace and which operates noiselessly Patent 1473511 J F Pearson 257 F Delaware Place Chicago, Ill

GAS STOVE—Designed for use as a heater the flame being controlled by openings in the combustion tubes Patent 1477505 J P Lane 171 Clinton St, New York N Y (See Fig 7)

IGNITER FOR GASEOUS FUEL BURNERS—Adapted to operate in connection with an electric lamp socket Patent 1476725 H C Pope and J H Fieldhouse address S B Smith, 526 Bryson Blk Los Angeles Cal

WATER FEED FOR STEAM BOILERS—For embodiment in a heating system for returning the water of condensation Patent 1477472 W A Whitmore Nelsonville Ohio

Machines and Mechanical Devices

COUNTER MOLDING MACHINE—For forming articles, such as the counters of footwear from flat blanks Patent 1471261 S J Heath, c/o Endicott Johnson Co Johnson City, N Y

TOASTER—Adapted for use in places where large quantities of toasted bread are necessary Patent 1471275 E J Moneuse, 108 W 22d St, New York, N Y

REVOLVING SHUTTER FOR MOVING PICTURE PROJECTING MACHINE—Which increases the amount of light reaching the screen and eliminates the flicker Patent 1471031 G Johnston, 206 No Laurel St, Richmond Va.

FLUID PRESSURE LIQUID PUMPING DEVICE—Primarily designed for pumping water out of mines. Patent 1470973 W J Hancock, Idaho Springs, Colo

PICTURE ATTACHMENT FOR TALKING MACHINES—Whereby a picture may be reproduced at or near the sound amplifier Patent 1468547 R A Rummel, 567 Ryerson Ave Woodridge, N J

MACHINE FOR CUTTING AND STRIPPING CANE—Which will cut the standing cane remove the heads, and strip the stalk. Patent 1468195 F S Curbelo, c/o E. M Amores, c/o Pan Am. Union, Washington, D C.

CLOTH MARKING DEVICE—By means of which a plurality of layers of cloth may be marked in one operation Patent 1468184 W Webber, 612 Saratoga Ave, Brooklyn N Y

BELT CUTTING AND TRIMMING MACHINE—Which will cut or trim a belt strap or the like Patent 1469154 J T Davison, 46 Holland Ave, Westfield Mass

EGG BEATER AND MIXER—For beating eggs, coatings frostings cake-doughs or mayonnaise Patent 1468826 A W Minney 2330 Glenarm Place Denver Colo

REVERSING MECHANISM FOR RECIPROCATING MEMBERS—For reversing the direction of a reciprocating member at predetermined points along its line of travel Patent 1468806. Wm Barker 5908 86th St. Portland, Ore

FAN—With mechanism for effecting the oscillation and to vary the length of the arc Patent 1468690 M M Glasser Glasser Mfg Co Exchange and Prioleau Sts, Charleston S C

TENSIONING DEVICE FOR CLOTH FOLDING MACHINES—To facilitate the folding of cloth upon a cutting table Patent 1469728 W P Levy, Spreckel Calif

FLOWING DEVICE FOR OIL WELLS—Which may be readily adjusted for use under a variety of conditions Patent 1470053 A Boynton, 1800 San Pedro Ave, San Antonio Texas

GRINDING BAR—For use in connection with lathes and other suitable machinery Patent 1470164 T R Halterman Box 2272 DeSoto Sta. Memphis Tenn

PORTABLE GRINDING MACHINE—I specially adapted for grinding the cylinders of engines Patent 1471412 R W Opfel Cuero, Texas

CABLE LUBRICATING DEVICE—For lubricating cable during movement Patent 1471583 A S Andersen c/o Andersen Dredging Co West Palm Beach Fla

COKE DRAWING MACHINE—For taking coke out of the beehive ovens and conveniently piling the coke Patent 1472730 R D Martin 718 1st National Bank Bldg, Fort Smith Ark

COMBINED PRESSURE REGULATING AND GOVERNING APPARATUS—Adapted to control a fluid under pressure Patent 1472662 J P Metzger, c/o The Leslie Co Lyndhurst, N J

COMBINED EGG CANDLING AND ASSEMBLING DEVICE—By means of which a plurality of eggs may be candled and deposited into the case Patent 1472673 W G Reagan, Lebanon, Ind

CLUTCH—Of the ring expanding type which makes use of centrifugal force in effecting engagement Patent 1472710 A H Wilson, 1118 So Home Ave Oak Park Ill.

CREAM SEPARATOR—Whereby the richness of the cream may be readily regulated Patent 1472085 P C Philip, Bowlus Minn

COLLAPSIBLE SOCKET—Adapted for use in removing various objects from wells Patent 1472714 C H Brown c/o Brown Welding & Machine Co Breckenridge, Texas

FARE COLLECTING DEVICE—For use in one man street car operating systems Patent 1472937 T W Pope, 1632 McLemore Ave., Memphis Tenn

MULTIPLE MITERING ATTACHMENT—For mitering machines, whereby a number of printers' rules may be mitered at the same time. Patent 1473521 H B Rubin 972 Sherman Ave, Bronx, N Y

AUTOMATIC STOP FOR TALKING MACHINES—Which will operate when the sound box has been moved to an inoperative position Patent 1473503 K Nalbantian, 25 East Kingsbridge Rd Bronx N Y

GRINDING MACHINE—For grinding and dressing the surface of metal parts Patent 1474121 P De Mattia c/o Munn Anderson & Munn Woolworth Bldg New York, N Y

WIRE BINDING DEVICE—For use in binding rubber hose to a pipe or fastening mop head Patent 1474265 D Kenner, 8304 Fig St, New Orleans, La

ADJUSTABLE PLATFORM—That may be used to raise and lower work to a convenient height Patent 1474249 J Ferrero P O Box 254, Angels Camp, Calif

CENTRIFUGAL PUMP—Which requires substantially the same amount of power to drive it at varying heads Patent 1473904. W C Dowd, c/o Dayton Dowd Co Quincy, Ill

ELEVATOR FOR STAIRWAYS—Adapted to be installed on any ordinary stairway and not obstruct its regular use Patent 1473813 C C Crispin 708 No 17th St, Harrisburg, Pa

STITCH WHEEL FOR KNITTING MACHINES—The use of which permits of the formation of larger loops Patent 1475045 J Bloom, 4014 Park Ave New York N Y

PROCESS AND MEANS FOR PLUCKING POULTRY—Which is adapted to remove all of the feathers from a fowl in a single operation Patent 1474702 G W Atkinson Emerald, Idaho

SAND BUCKET—For removing sand rock, or loose obstructions from a well casing Patent 1474707 M L Crowl 1008 E. Orman Ave Pueblo Colo

COIN DISPENSING DEVICE—Which may be readily changed from a 'payer' to a changer without altering the operating mechanism Patent 1475585 W G King, 1150 No Blvd Oak Park Ill

STOP MOTION FOR SPINNING FRAMES—With mechanism for preventing the over filling of the bobbins Patent 1475220 J W Cauthen 626 Ridge Ave Kannapolis, N C

VALVE ACTUATING MECHANISM—Whereby fluid valves may be operated without the use of projecting heads Patent 1477419 A G Bertram Cochran Ave and 36th St. Flushing N Y (See Fig 8)

STIFF HORNING MACHINE—For horning or giving a reversely curved shaping to an end of a window stile Patent 1476666. J T Williams 2010 So Alameda St, Los Angeles Calif

COTTON CLEANER—Which breaks the mass of cotton into small lumps separating the seeds and trash from the cotton Patent 1476010 E P Taft and G Barton, c/o J P King Mfg Co Augusta Ga

AUTOMATIC STOP FOR MOTION PICTURE MACHINES—Whereby the motor unwinding the film will be automatically brought to a stop upon the film breaking Patent 1476006 M I Phimister c/o Colonial Theater Green Bay, Wis

LOOP SEWING MACHINE—Particularly intended for joining knitted fabrics and knitted parts of wearing apparel Patent 1476658 A I Traver Philmont N Y

GUIDE AND ADJUSTER FOR LOOPER NEEDLES—Used in looper machines employed to join together knit fabric Patent 1476659 A L Traver Philmont N Y

PHOTOGRAPH PRINTING MACHINE—Designed to decrease the time of printing operation, the print when fully exposed being dis-

charged on the application of a new sensitized sheet. Patent 1476574 P Anderson, 82 Franklin Ave., New Rochelle, N Y

LUBRICATING DEVICE FOR WINDMILLS—Which automatically lubricates the various bearings and moving parts Patent 1477519 O Olsson, Ord, Neb

MACHINE FOR SHAPING AND FORMING FABRIC CASES—Such as those containing musical instruments, whereby the fabric may be stretched over a die Patent 1477437 J Gaynor, 251 Washington St, Jersey City, N J

GATE AND BARRIER CONTROL MECHANISM—For use in self service stores, to predetermine the course of a customer Patent 1477193 M R. Hutchison c/o Munn Anderson & Munn, Woolworth Bldg New York N Y

YARD METER FOR HEMSTITCHING MACHINES—For accurately measuring and registering the linear yards of goods, passing through the machine Patent 1477049 L N Faubion, 328 So Monroe Ave Kansas City, Mo

ECCENTRIC—That is of sectional type and may be applied to a shaft or axle without disturbing the latter Patent 1477521 E D Richards, Ferriday La

WELL DRILLING APPARATUS—Applicable to any type of rotary machine used for prospecting subterranean strata Patent 1477563 H C Hirschfeld and R S Mayer, 500 H St N E Linton, Ind

DEVICE FOR OPENING AND CLOSING SLIDING DOORS—Particularly applicable to steel freight car doors Patent 1478326 W J Dooley, 551 W 174th St. New York, N Y

CANE CUTTING APPARATUS TRANSMISSION GEAR—Adapted to be secured across the forward end frame members of an automobile Patent 1478327 A W Dunn and G Potter 5540 Foothill Blvd Oakland Cal

BUCKET FOR STEAM SHOVELS OR THE LIKE—Having a drop door as a bottom which closes automatically Patent 1478301 W C Shea, 6231 Echo St Los Angeles Cal

LOWERING AND RAISING DRUM FOR LIFEBOATS—Adapted to be operated by one person in either raising or lowering a boat Patent 1477529 S E Allbin c/o Mayer Life Boat Co, Seattle Wash

TUBE SUPPORT FOR DEEP WELL PUMPS—Which may be quickly dislodged when necessary Patent 1477714 J Penrod and R D Thompson 1241 E 9th St Okmulgee Okla

APPARATUS FOR CALCINING LITHOPONE—Which will eliminate or control the formation of zinc oxide as desired Patent 1478,347 J L. Mitchell 17 W 108th St, New York, N Y

FEED MIXING DEVICE—For the thorough mixing of grains or other feed Patent 1477586. C T Patterson, R No 4, Spring field Mo

CLAY PIGEON TRAP—Which will automatically change the angle of departure of successive targets. Patent 1477942 C O Carothers Kenton, Ohio

TOOTHLESS SLIP AND ELEVATOR—Adapted for use in connection with oil, gas and water wells. Patent 1477709 J E. Le Bus, c/o Le Bus Rotary Tool Co, Electra, Texas

MACHINE FOR CASTING STEREOTYPE PLATES, and the like Patent 1478935. C Winkler, Berne, Switzerland

Medical Devices

OPERATING TABLE—On which the patient may occupy a horizontal position a sitting position, or a position between the two Patent 1475143 O B Schillberg Ritz Chambers 48th St & Madison Ave New York N Y

Prime Movers and Their Accessories

VALVE FOR INTERNAL COMBUSTION ENGINES—Which assists in breaking up the particles of fuel Patent 1471955 R P Grieve, Lorraine Court, 501 No Grand Ave, Enid, Okla.

ROTARY ENGINE—Whereby the supply of fluid under pressure to the expansion chambers or cylinders is automatically controlled Patent 1478249 F G O'Rourke Box 151, Blarsdell, N Y

CLEANING IMPLEMENT—Adapted for use in connection with the cleaning of carbon from spark plugs. Patent 1475118. G A Hoyem, Lonnep, Mont.

SPARK PLUG—Which will have a down ward pitch when used in valve-in head motors having spark plugs set horizontally Patent 1476350. L F Reynolds and J S. Stewart, c/o J Stewart, Mound City, Mo

FIRE EXTINGUISHER—For automobiles, or other devices using internal combustion engines. Patent 1476594 C A. Conover, 54 Leroy Place, Newburgh, N Y

LOCOMOTIVE SUPERHEATER — Permitting the feeding of superheated steam to the steam receiving appurtenances and instrumentalities Patent 1476150 M M. Crowley, 915 12th St., Sioux City, Iowa

ROTARY ENGINE—Rotated under the expansive force of steam, compressed air or the like Patent 1478352 G Pagonis, 5 Columbus Circle, New York, N Y

MISS DETECTOR FOR INTERNAL-COMBUSTION ENGINES—With means for indicating to the operator the particular cylinder which is misfiring Patent 1477782. F H Vallton, Box 220, Deer Lodge, Mont.

AIR MIXING DEVICE—With means for regulating the flow of air, according to the speed of the engine Patent 1477988 H Wehr and J G Pineau, 9200 78th St., Woodhaven, N Y

PISTON—For internal combustion engines, with means for varying its size to compensate for wear Patent 1478963. R. C Jones Jefferson, N Y

Railways and Their Accessories

TROLLEY LOCK—By means of which the trolley wire may be retained in proper relation to the trolley wheel Patent 1473567 W M Lane, 16 Harlar St., Glens Falls, N Y

BULL BOARD FOR CATTLE CARS—Consisting of a bar across the inside of the doorway to keep the cattle from the opening Patent 1473494 F S Miely, Gentry, Ark.

TROLLEY SHEAVE—For the purpose of supplying current from the trolley wire to the motor of a car Patent 1474241 J J Crapper, 407 2d St. Brooklyn, N Y

RAILWAY TIE AND RAIL FASTENING—Constructed of a cementitious material, which will take the place of wooden ties. Patent 1475106 J F Balme, Jr, 755 Tremont St Boston, Mass

GUARD AND SIGNAL FOR RAILWAYS ETC—To afford warning and offer a barrier to the passage of a vehicle Patent 1477438. A T Gookin 9 Brattle St., Cambridge, Mass

SAFETY DEVICE FOR RAILWAYS—Adapted to prevent trains from running into one another Patent 1477486 M K Healy, 2612 Ave I Brooklyn, N Y

TRAIN CONTROL SYSTEM—Which automatically stops the train, in the event the engineer fails to observe the signal Patent 1478273 I A and J C Call, 5 Beekman St New York, N Y

Pertaining to Recreation

TOY—By means of which an arrow may be projected into the air Patent 1468223. U Baltich, 841 Maryland St., Gary, Ind

EDUCATIONAL TOY—Which will develop the artistic facilities while demonstrating a comparison of size Patent 1475112 W N Grimes and J Muenamay, 3316 Dawson St., Pittsburgh, Pa

TOY—Simulating the movements of an airplane when traveling on the ground Patent 1475059 A L Erickson Gen'l Delivery, Ketchikan, Territory of Alaska

GAME—Adapted for use to afford entertainment and amusement to children Patent 1474934 N J Jacobson, Box 291, Phillips, Wis

GAME APPLIANCE—By which the hand of a player will be prevented from being bruised or injured Patent 1477460 H B Smith, 139 Lefferts Place, Brooklyn, N Y.

Pertaining to Vehicles

RESILIENT VEHICLE WHEEL—Wherein provision is made for excluding the entry of foreign matter such as mud Patent 1470-071 A B Fuhr Macomb, Ill

STRAINER—Particularly for use in draining gasoline before it enters the pipe line Patent 1471293 C H Sturgis, c/o B F Berry Coal Co Granville, Ill.

LIQUID RESERVE DEVICE—Adapted for use in connection with the outlet of a gasoline tank Patent 1469947 R. E. Mudd, 715 E. 61st St, Chicago, Ill.

CHAIN CONNECTOR—Particularly constructed for fastening the opposite ends of a tire chain Patent 1469164. E. N. Malvern, Burlington Junction, Mo.

BRAKE FOR SELF PROPELLING VEHICLES—Actuated by a fluid for partially or wholly stopping rotation of the drive shaft. Patent 1470192. F H Ricker, 1711 Scott Ave., Los Angeles, Calif.

HOLDER FOR MAGNETO CONTACTS—For securing the contact and binding post in proper position upon the crank-case. Patent 1470093 L. A. Loundagin, c/o Harvey Valley Trans. Co., Crane, Oregon.

DETACHABLE TIRE CARRIER—Which may be used for carrying a second spare tire. Patent 1471268. W E. Kelly, 1176 Williams Ave, Portland, Oregon

AUTOMATIC INFLATING DEVICE — Constructed to automatically control the supply of fluid under pressure to tires. Patent 1469201 H F Whitted and F G Schulse, Santa Paula, Calif.

VEHICLE TIRE—The tread of which will not readily become punctured. Patent 1471949 J T Doranski, 11347 Watt Ave, Chicago, Ill

AUTO LIFT—Which may be operated with the least amount of energy Patent 1471695 E. H Kelley and G A Stewart, Jr 728 Water St, South Brownsville, Pa.

TIRE MILEAGE INDICATOR—Capable of attachment to a tire shoe Patent 1471981. A G Sargent, 39 Center St., New Haven, Conn

DIFFERENTIAL—In which all of the parts may be bodily removed from the rear axle housing Patent 1471915 V W Page c/o Victor Page Motor Co., Melrose Ave., Stamford, Conn

AUTOMOBILE STEP—Which will replace the well known running board Patent 1471972 H D Miller, Box 6, Lawton, Okla

DIRECTION INDICATOR FOR MOTOR VEHICLES—Which is visible by day or night, and operable from the steering wheel of the vehicle Patent 1472186. C E. Morris, Grimes, Calif

BRAKE STRUCTURE—Pertaining more particularly to internal brakes Patent 1471914 V W Page, c/o Victor Page Motor Corp., Melrose Ave Stamford Conn

TIMER—Of simple construction, especially intended for use on Ford cars. Patent 1472180 H G Lorenson, Box 63, Newman, Calif

AUTOMOBILE IDENTIFICATION DEVICE—Which can be readily applied to any car, whereby the owner or operator may be readily identified Patent 1473556. M. Iafrate Box 151, Shanesokni, Pa

AUTOMOBILE LOCK—By which the control pedals are held in an inoperative position. Patent 1473469 C Cynamon, 530 W 163d St, New York, N Y

CLUTCH—For connecting a driving shaft with a driven shaft. Patent 1473564 J Klepper and C Klepper, 10-12 2nd Ave., New York N Y

AUTOMOBILE TOOL—For replacing transmission covers on Ford cars Patent 1473114 M McIntyre, 139 Center St., Healdsburg, Calif

CLUTCH LEVER ATTACHMENT FOR TRACTORS—For throwing the clutch in or out and applying and releasing the brake Patent 1478466. L Conboy, c/o C V Henderson, Asquith, Saskatchewan, Canada

TOOL BOX—Which may be readily applied to the running board of an automobile Patent 1478319 S P Ray, Urich, Missouri.

CLOTHES CONTAINER—Which is accessible through the top of the body of an automobile at the rear seat. Patent 1478161 V B Rogers, Star Route "A," Canutillo, Texas.

COMBINED VEHICLE FENDER AND BUMPER—Which will serve as a means for fending off or picking up pedestrians. Patent 1474263 W Jaeger, 902 Willow Ave., Hoboken, N J

PEDAL PAD—For preventing the foot from slipping from the face of a pedal. Patent 1474320 B De Mattia, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N Y

FOLDING STEP—Adapted to be operatively applied to an automobile or like vehicle. Patent 1478858. S Koeberlin, Fremont, Neb.

LOCKING DEVICE AND ALARM FOR AUTOMOBILES—Which renders the ignition system inoperative, and sounds an alarm if tampered with. Patent 1474262. F Hoyt and C. F Holmes, 53 Pleasant St., Newbury port, Mass.

BRAKE APPARATUS FOR MOTOR VEHICLES—By means of which the wheels may be retarded, in variable degrees or locked against rotation. Patent 1476170. F H. Merian, The Stillwell, between 8th and 9th on Grand Ave., Los Angeles, Cal.

COMPOUND FOR POLISHING—For use with automobiles, wood and metal work of every character. Patent 1478947. T. Bailey, c/o O. Waldkirch, Morgan & Hamilton Co., Nashville, Tenn.

COLLAPSIBLE CORE—Such as are used in the manufacture of pneumatic tires, more particularly the casings. Patent 1475109. P. De Mattia, c/o Munn, Anderson & Munn, Woolworth Bldg., New York.

AUTOMATIC GEAR SHIFT AND SPEED CONTROL—In which the manual shifting of the speed gear is obviated. Patent 1475265. H R. Hoffman, 2069 Humboldt Blvd., Chicago, Ill.

DIRECTION SIGNAL — Located near the steering wheel of a car and within easy reach of the operator Patent 1476616. W A. Jacobus, R. R. No 2, Box 42, Wood River, Neb.

AUTOMOBILE SCREEN—For preventing flying bugs or insects from striking the operator, or occupants of the car Patent 1476,-336. V D Hitchings, 538 Front St., Norfolk, Va.

AUTOMOBILE SPRING REGULATOR—Adapted for use in connection with the spring suspension to cushion their action Patent 1477433. W C Engel, Ashland, Pa.

UNCHANGEABLE MOTOR NUMBER—So connected with part of the engine that it cannot be changed or removed without detection Patent 1477466 L P Terhaar, 256 W 84th St., New York, N. Y

RESILIENT TIRE FOR VEHICLE WHEELS—Comprising a chambered body, a plurality of fibers enclosed thereby, and an annular air chamber Patent 1477518. C Noel, 85 Rue Gravel, Levallois, Perret, France

MOTOR VEHICLE SUSPENSION—Composed of a half-elliptic main spring, and a quarter-elliptic supplementary spring. Patent 1477,477 O R. Dunnet, Oharra, West Coast, South Australia, Australia.

BUMPER FOR VEHICLES—Adapted to hold characters which supply information, as well as serving as a bumper Patent 1477067. J C Lawson, 351 E. 1st St., Los Angeles, Cal.

AUTOMOBILE DIRECTION INDICATOR — In which the signal arm is illuminated upon reaching an extended position Patent 1478007 F O Gray, Box 330, Crystal Lake City, Ill

TAPE FOR WHEELS—For holding a wheel in position during the installation of the hub, or repair Patent 1477975 J Olson, cor 7th and D Sts., Lewiston, Idaho.

SHOCK ABSORBER—Wherein the springs will absorb both major and minor shocks. Patent 1477791 E. A. Traver, c/o Geo Jensen, Thornton, Cal.

CIRCUIT CONTROLLER—Adapted for use in connection with signalling systems on automobiles. Patent 1477917 F M Smith, 320 No 6th St., Corvallis, Ore.

CLUTCH BAND—For use in connection with Ford transmission Patent 1477577 J Malligan and C R. Lytle, Point Marion, Pa.

Designs

DESIGN FOR A BOTTLE—Patent 62804 H K. Quan, 26 Pell St., New York, N Y

DESIGN FOR A RING—Patent 62922. J. Simmons, 187 W 64th St., New York, N Y

DESIGN FOR A CANDLE—Patent 63032 A. E Glistridis, 1450 E. 95th St., Brooklyn, N Y

DESIGN FOR A TIRE TREAD—Patent 63051 B. Gottlieb, 73 West Broadway, New York, N. Y

DESIGN FOR A LIGHTING FIXTURE ARM. Patent 63191 A. Miller, c/o Radiant Lighting Fixture Co, 83 Bleecker St., New York, N Y

DESIGN FOR A WOVEN FABRIC. Patent 63196. F Reeves, c/o Gardner Textile Co., 35 White St., New York, N Y

DESIGN FOR A HAND BAG. Patent 63186. M Miller and M. L. Kurtz, c/o Murray Miller, 52 W 46th St., New York, N Y.

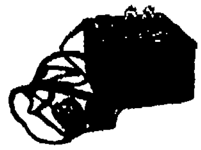
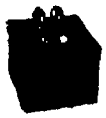
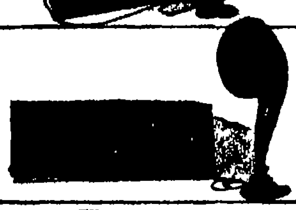
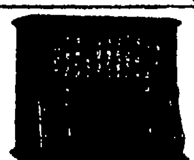
DESIGN FOR A BUILDING TILE. Patent 63233. Q Monier, P. O. 411, Tucson, Ariz.

DESIGN FOR A FINGER RING Patent 63280. H. Bredavsky, 64 Fulton St., New York, N. Y

DESIGN FOR A GAME BOARD. Patent 63366. J. W Hanley, 294 E. 51st St., New York, N. Y.

DESIGN FOR A LIGHTING FIXTURE ARM. Patent 63058. I. Rosenblatt, c/o Globe Lighting and Fixture Co., 124 [illegible] New York, N Y.

Radiolas!

	MODEL †	PRICE	APPROXIMATE RANGE	TYPE OF ANTENNA	DEGREE OF SELECTIVITY
	**Radiola III** With two WD 11 Radiotrons and head telephones	$35	Up to 1500 miles with headphones. Local stations on Loudspeaker	Outdoor or indoor antenna.	Improved selectivity. Minimum radiation.
	**Radiola Balanced Amplifier** To be used with Radiola III With two WD 11 Radiotrons.	$30	Gives Loudspeaker operation with Radiola III up to 1500 miles under favorable conditions	Outdoor or indoor antenna.	
	**Radiola III-A** with four WD 11 Radiotrons, head telephones and Radiola Loudspeaker Same without Loudspeaker	$100 $65	Loudspeaker operation up to 1500 miles under favorable conditions	Outdoor or indoor antenna	Improved selectivity. Minimum radiation
	**Radiola Regenoflex** with four WD 11 Radiotrons and Radiola Loudspeaker Same without Radiotrons or Loudspeaker	$206 $150	Loudspeaker operation up to 2000 miles under favorable conditions	Outdoor or indoor antenna.	Extraordinary selectivity. Non radiating
	**Radiola X** with four WD 11 Radiotrons. Loudspeaker built in	$245	Loudspeaker operation up to 2000 miles under favorable conditions	Outdoor or indoor antenna	Extraordinary selectivity. Non radiating
	**Radiola Super-Heterodyne** with six UV 199 Radiotrons and Radiola Loudspeaker Same without Radiotrons or Loudspeaker	$286 $220	Loudspeaker operation up to 2000 miles with internal loop. With external loop up to 3000 miles under favorable conditions.	No antenna (Concealed small loop built into set.)	Super selectivity. Non radiating
	**Radiola Super-VIII** with six UV 199 Radiotrons. Loudspeaker is built in.	$425	Loudspeaker operation up to 3000 miles under favorable conditions.	No antenna (Concealed large loop built into set.)	Super selectivity. Non radiating

† All Radiolas sold without batteries. ** Only dry batteries used.*

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The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals Other digests appear elsewhere in this issue

Automotive

Unique Tests on Wheel Slip were made by *The Autocar* (see No 1,474) in an effort to determine exactly what the rear wheels do in various circumstances Use was made of a device which shows accurately the number of revolutions or parts of a revolution, made by either of the rear wheels relative to the other A most interesting point became apparent, as independent of the action of the differential when the car was taking curves or corners there was a continuous movement due to the difference in size of the two tires. This is due chiefly to difference in inflation and imposes a constant extra duty on the differential The continuation of the test brought to light the fact that whereas the average motorist would assert that he knows of a considerable number of bad roads which would certainly make the wheel slip, yet experience with this instrument proved that it was exceptionally difficult to find a road sufficiently bad to cause any slip at all the ordinary bumpy road having no effect whatsoever on a light car With a heavy car, wheel slip on a road with many pot holes was quite common though it is almost impossible for the crew of the car to tell what is happening

The Balloon Tire will probably have a greater effect on the design of the motor car than is at first thought apparent. Whatever the immediate effects on the tire industry may be, a new impetus will be given ultimately to the whole motor car business by the advent of balloon tires assuming that they are an undoubted success The additional cushioning that the low pressure gives the car will make it possible to redesign the whole chassis and perhaps reduce the weight of some cars by a fifth or more Such a saving in materials should have a tendency further to lower prices It may be found that four wheel brakes have no particular advantages when balloon tires are used, because of the better traction they afford, with consequent increased braking efficiency and reduction of the tendency to skid Also the use of chains may be greatly curtailed On the other hand snubbers or shock absorbers may become almost universal if balloon tires generally accentuate the vertical oscillations of the body Then there is a possibility that the better utilization of power by the balloon tires and the reduction of car weight will permit of smaller engines with a resultant saving in fuel consumption This all tends toward a lowering of the cost of motoring and a pushing of the much discussed car saturation point further into the future.—*Ind Rubber World*, 69 5 2 pp

Gasoline from Casing Head Gas.—At present there are two principal sources of gasoline The refining of crude oil by distillation and 'cracking' of the heavier distillates provide the larger part. A smaller amount is got by extraction from certain natural gases, particularly from that known as casing head' gas The rise in price and enormous consumption of gasoline within the last few years have caused more attention to be given to the extraction process and have made the method an attractive one particularly in oil fields that heretofore could not be worked at a profit The gasoline extraction process is a comparatively simple one, consisting essentially of compressing the gas and then cooling it A gasoline extraction plant generally comprises one or more vacuum pumps, two stage compressors of either the straight line or duplex type, coolers, accumulating tanks blending tanks, gasoline traps, pipe fittings and some form of prime mover The principal merit of the extraction process is that it opens up a field for the production of gasoline at moderate cost from sources unavailable previous to its development, and in some cases from gases which otherwise would go to waste. In fact it is authoritatively stated that the gasoline extraction process has made available for public use many millions of gallons of gasoline annually that otherwise would not be available —*Can Min Jour*, 45:4, 2 pp

The Temperatures Required to Vaporize Present day Fuel by means of the so-called hot spot manifold and the temperatures available in the exhaust under different running conditions, are the subjects of researches that have been carried out at Purdue University Contrary to what might be expected, the tests showed the cooling water temperature to have little influence on the exhaust gas temperature. Increasing the cooling water temperature from 70 to 212 deg Fahr decreased the exhaust temperature less than 50 deg It is concluded that the best cooling water temperature depends more upon lubrication than carburetion requirements. The exhaust temperature varies from a minimum of about [illegible] deg to a maximum of nearly 1500 deg Under normal operating conditions with a well designed manifold the temperatures are usually high enough to deal with a fuel somewhat less volatile than our present gasoline, whereas at low idling speeds the temperatures are hardly adequate for our present fuel, but as a result of the reserve heat in the manifold an engine can idle for about 15 min before the temperature reaches a minimum In practical operation the condition most difficult to meet is the sudden opening of the throttle after a long period of low speed idling While idling the pressure in the inlet manifolds is very low, under which condition the fuel vaporizes at lower temperatures than at atmospheric pressure In addition, during periods of idling the temperature of the metal of the spot drops to a minimum Sudden opening of the throttle draws a large amount of fuel into the manifold at nearly atmospheric pressure and these two conditions both demand additional heat and constitute the most severe conditions to which the manifold can be put.—*Automotive Eng*, 50 3, 4 pp.

American Farm Tractors are still in the running abroad Altogether, twenty nine makes of tractors were exhibited at the autumn tractor trial at Essone-Corbeil France Of this number eleven were American and the rest French, with the exception of three The relative amount of interest displayed in the French and American makes indicated quite clearly that the French public are more than partial to the latter, says Assistant Trade Commissioner David S Green in a report to the Commerce Department. With the exception of the new Citroen caterpillar tractor performances of the French models did not arouse much enthusiasm among the onlookers —*Automotive Ind*

Do Mufflers Cause Power Loss?—Far less than is generally thought says a writer in *The Autocar* (50 1478) Since 1914 engines of the higher efficiency type have undergone a considerable change, especially in the direction of increased piston speeds and, what follows as a natural corollary increased speed in the flow of exhaust gases. Tests were made, using a four-cylinder motor first with a plain pipe, and then with the standard form of silencer A curve plotted from the two series of tests indicates not only that there is a negligibly detrimental effect introduced by quieting the exhaust, but that the actual horse-power delivered is greater with the silencer than without it at high speeds

American Oil-Shale "Industry" Still Experimental.—No standard retorting or refining practice for oil shale and shale oil has yet been established in the United States according to Technical Paper 3244 Bureau of Mines. Many processes have been proposed, and perhaps 25 to 30 experimental or demonstration plants have been erected in different parts of the country Practically without exception, however, these plants are too small to be considered as commercial, or to give operating data that would be of much value in estimating water requirements. The proposed retorts for treating oil shade may

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(*Continued from page 266*)

be grouped in a general way under two heads (1) Those in which dry destructive distillation takes place and (2) those in which distillation progresses in the presence of superheated steam or gas In the well known Scottish type of retort, used for many years in Scotland steam is used. Whether or not Scottish practice will be followed in this country remains to be seen, but as the Scottish plants are today the only ones operating on a large commercial scale, knowledge of their water requirements will be of value in estimating requirements for plants in the United States If later on American retorts should be designed differently so that they use less water or none at all this development will in many cases be a point decidedly in their favor

Electricity

Electrification of Farms in Sweden.—Abundant mountain streams make the distribution of electrical power to Swedish farms a comparatively simple matter According to an article in *Elec World* (83 4 5 pp ill) at the end of the year 1921 more than 38 per cent of the arable land was electrified in a potential sense at a cost of between 1½ and 2 per cent of the whole national fortune A thorough investigation of the farmers needs of the possibility of cutting down the total cost of energy and of means to raise the money for local distributing networks has led to a plan that is now being adopted in large parts of the country This method aims at the forming of local joint interest unions among the farmers under the terms of special legislation o e unio i embracing an area with a radius of about four miles Every partner has to sign one share bond for about $5 per acre of his cultivated ground He has besides t f rnish a certain number of poles from his own property haul materials and pay certain d es proportional to the number of his share bonds Cultivating the soil by electrically driven tools is still a problem that is waiting for a satisfactory solution Several methods have been tried The latest (the Forsblads system) comprises a tractor with an electric motor and an armored cable that is coiled and uncoiled by a special device on the tractor thus having a considerabl ra ll s of action It seems to open new possibilities Electric plows had previously been used in Sweden only experimentally Electrical energy is also used for heating water for the cattle and in the dairy Quite a few fell is the electric conservation of fodder in silos

A New Motor has been developed which combines the otherwise conflicting qualities of high efficiency high torque constant speed and high power factor The plain induction motor has the inherent disadvantage of operating at a poor power factor The squirrel cage induction motor develops a very high torque if the resistance of its rotor windings is high but under these conditions the motor operates at low efficiency It is possible to raise the efficiency of the motor by lowering the rotor resistance but when this is done a low starting torque results Synchronous motors have the advantage of operating at constant speed but usually have low starting torque and low pull in torque To combine high efficiency high torque characteristics constant speed and high power factor a motor known as the Flynn Weichsel motor has been developed This is essentially a combination of the induction motor and synchronous motor In addition the revolving member has a winding which is essentially a synchronous motor exciting field These two windings are respectively connected to slip rings and a commutator mounted on the rotor shaft. The operation of the motor is such that it starts out as an induction motor and therefore, has induction motor characteristics comes up to synchronous speed and operates as a synchronous motor and under very heavy loads pulls out of synchronism and again automatically becomes an induction motor with high pull out torque —*Coal Age*, 25 4 1 p

High Frequency Telephone Communication on 140,000-volt lines between Jackson and Battle Creek, Mich, marks a distinct advance in the art. The basic advantage of the high frequency telephone is the use of the power lines themselves as a communication circuit which, owing to its superior mechanical strength affords a more reliable circuit than the usual telephone line. For distance exceeding 15 miles this system is cheaper to install and maintain than a wire line, and it has a most promising future for central-station use. The high-frequency

currents are superimposed on and received from the power lines by antennas strung on *same towers as the transmission lines* The operation of calling is exactly the same as with a standard form of automatic telephone For example when the load dispatcher at Jackson desires to communicate with the station operator at Battle Creek he merely lifts the receiver from the hook of his desk set and dials the number assigned to the Battle Creek station The act of unhooking starts up the high frequency telephone apparatus at the Jackson steam plant and sends out a series of modulated high frequency impulses over the 140 000-volt power line This impulse sequence is picked up by the receiving antenna at Battle Creek where it is led through the high frequency receiver and after being amplified actuates a pair of relay contacts which notch up a selector If this selector pauses on the proper contact point a circuit is completed through the station call bell, which then rings until the station operator unhooks and answers the call The act of unhooking starts his high frequency transmitter and enables him to communicate with the load dispatcher just as though he were using a standard wire line automatic telephone It is to be particularly noted that the installation provides for the simultaneous two way communication called duplex that is, both parties are able to talk and listen at the same time as is the case with the commercial wire line telephone —*Elec World*, 82 25, 4 pp, ill

A Great Hydroelectric Plant which needs no man about the place while it furnishes power to the industries of New England is located at Searsburg Vt on the *upper waters of the Deerfield River* Excepting for the occasional visit of an engineer it operates in complete solitude It is wholly *automatic in its control* If *serious trouble* arises in its mechanism it shuts down and stays shut down until experts have made things right again But if the trouble is trifling and of a sort to correct itself the big waterwheel and generator rest for a time until conditions are again normal and then start up again turning out their thousands of horse power Its turbine rotating at 300 revolutions per minute drives a generator having a capacity of 6500 horse power The only help from human beings that is required is an occasional looking over and attention to the lubricating system and remedying of any trouble, or set the governor mechanism to produce a given amount of power or to start up the turbine at some predetermined moment If left to itself to run as it wants to the turbine will start up when water arrives in sufficient volume and will shut down when the water falls below the efficient limit Should a bearing become heated the penstock gate closes in which case the wheel will stay idle until experts come and remedy the trouble But when generator windings become too warm *the unit shuts* down only so long as the temperature remains abnormal When the windings cool *off turbine and generator run along merrily* again In times of high water, when the river flow itself is ample and storage water is not a factor the Searsburg plant runs right along all by itself day and night a constant dependable source of power It is here that another automatic function is important, the regulation of power generated to the load imposed When the load falls off the action of the governor causes the supply of water to decrease proportionately, which means the production of a smaller amount of power —*Science Service*

General

Poor Germany?—*Germany is steadily* winning back her pre war trade An instance is given in an editorial in *Engineering* (No 3028), where the import trade of South Africa comes under discussion In 1919 the importation of goods from Germany only amounted to a few thousand pounds in value This was increased to over one million pounds in 1921, and a further extension to over two and a half millions was shown in 1922 The exports to Germany from South Africa—which however, do not include any goods resold to Germany from the United Kingdom and other European countries—show similar expansion, and have reached the figure of 2,875,000! For the same period American trade has suffered a decline. German competition has been shown most keenly in all classes of domestic ware. In the aluminum utensil market German goods account for five-sixths of the total trade, and somewhat similar characteristics are apparent in the trade in enamel ware When the returns for agricultural machinery are reviewed it is apparent that German competi

tion is keenest in the market for dairy utensils and ploughs. The old German position in fencing wire and other wire products has been re established Germany also supplies a large proportion of the iron and steel requirements of the Dominion In this field she has two-fifths of the trade in rails, one-quarter of the market for plates and supplies one-half of the importation of iron and steel pipes. A markedly reduced demand for her general machinery and electrical goods is, however, manifest. The chief import obtained from America is mineral oil and its associated products Last year American machinery and electrical goods amounted to 1 600, 000£, but this year s report shows a reduction to 583,000£ There are markets such as that of typewriters, where America had practically a monopoly but is now being hit by competition Britain now holds 20 per cent of the typewriter market and Germany 13 per cent The American share of the trade in clocks and watches has now mostly gone to Germany and Switzerland

How Is Steel Wool Made?—Certain American manufacturers produce steel wool from high manganese bessemer wire by attaching one end to a power-driven drum. The wire is pulled under several knife blades of the saw tooth type arranged in tandem in an inclined position similar to a bit in a hand plane Triangular shaped slivers of steel are shaved from the wire and when about seven eighths of the wire is converted into steel wool the residue becomes too thin to withstand the pulling strain and is discarded In later type machines the wool is produced by drawing the wire through circular cutting dies Foreign made steel wool is produced by first shaving a thin fiber from soft steel wire in order to present a flat surface to the cutting tool The wire then is stretched over a frame but beneath the cutting tool in such a way that the wire is shredded into filaments of triangular-shape cross section This shape renders the wool sharp for abrasive and polishing purposes.—*Iron Trade*

Ruling a Diffraction Grating for astronomical use is perhaps the most difficult task ever faced by man, says a writer in *Amer Machinist* (60 5) Some idea of the difficulty may be gained from the following specifications for a 6½-in plane grating The ruled surface is to measure 4x5 in and it shall consist of 75 000 lines, each 4 in long Each line must be so nearly straight, that the maximum deviation from absolute straightness shall be less than 1/1 000 000 inch. The spacing must be so accurate that no line must be 'out' of its ideal position by more than 1/1,000 000 inch All the lines must be accurately alike in shape, that is, the width, depth and form of groove must be the same for all The machine for doing this ticklish piece of work is described at great length in the source mentioned, and is now in operation at the laboratory of Mt. Wilson Observatory in Pasadena, California. The grating to be ruled by means of a diamond is a polished blank of very hard alloy The wormwheel for operating the lead screw which feeds the work table under the diamond carriage, has 1,200 teeth. The lead screw has a pitch, expressed in fractions as 0 07874 in The worm makes exactly one turn in feeding for each line to be ruled Therefore the advance of table and work for each movement is 0 07874 ÷ 1200 or 0 0000656 inch.

Gas as an illuminant has largely given way to electricity Offhand, one might be tempted to make the statement that its manufacture was declining Yet, says *The Am Gas Journal*, more than one billion cubic feet of gas a day were used in the United States last year This represents a 20 per cent increase over the previous, and itself a record year Its manufacture thus appears to be increasing This production would be enough to fill the "Shenandoah 465 times each day In making a digest of the technical press one is constantly being reminded that the gas industry is a large one It supports an exceptionally prolific trade press and the contents of that press show that the industry is keen in its competition with electricity as a source of power and light generation. Every opportunity to exploit new openings for gas sales is played up strikingly by the special press of the gas industry This keenness of competition is reciprocated by the electrical industry, and the public benefits by the practical results of the contest

The Fight Against the Cotton Boll Weevil has at last been brought considerably nearer ultimate success by the discovery that calcium arsenate is the best existing "dope" for these destructive pests. Now comes a new and better process for making

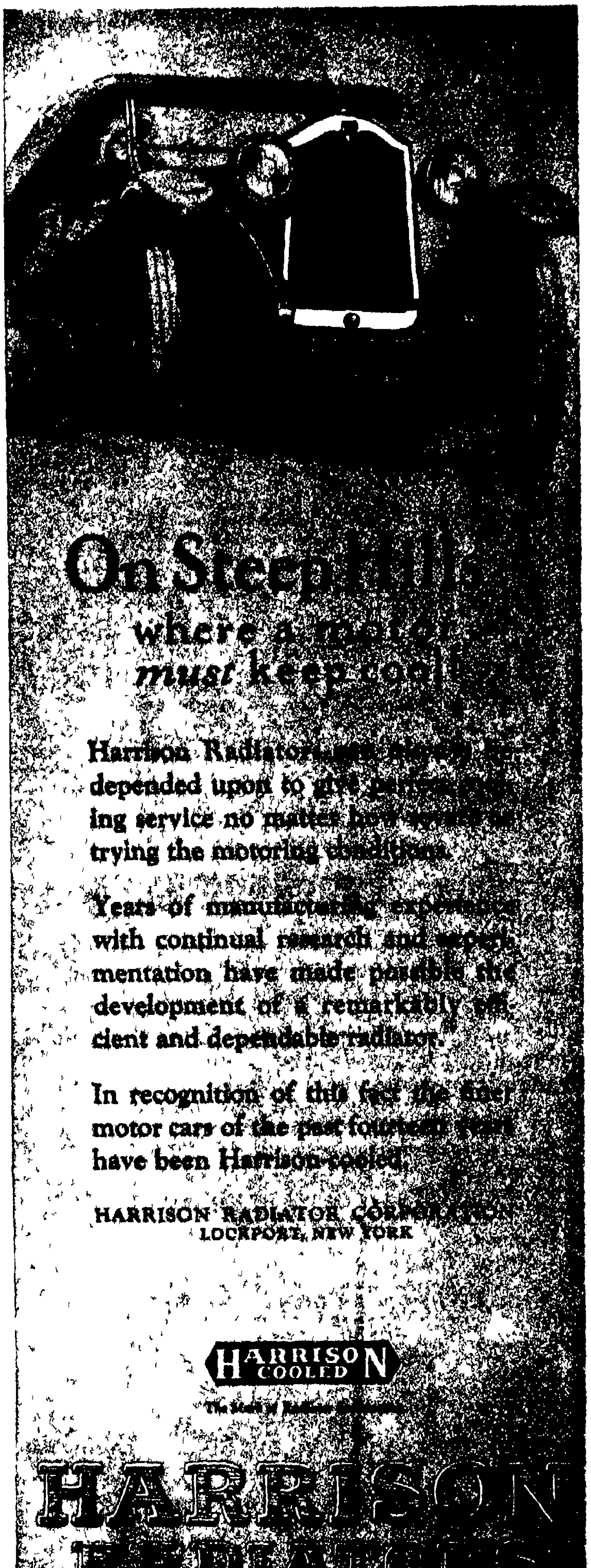
that chemical, accompanied by the hope, expressed by *Mfrs. Record*, (85-6, 1 p), that it will eventually be lowered in cost to the grower A process perfected after several years of arduous labor by A. M. Kennedy, of Montgomery, Ala., and Dr Stewart J Lloyd, of the University of Alabama, department of chemistry, under the direction and at the expense of the Alabama Power Company, will be used for the production of the poison The General Electric Company also materially assisted in the experiments giving both Dr Lloyd and Mr Kennedy access to their Schenectady Research Laboratories and the assistance of their engineering staff. The old process involves the use of large quantities of nitric acid in the oxidation of white arsenic, expensive both as to cost of production and investment. The Kennedy process is described as an extremely simple one in which electricity takes the place of the nitric acid, thus minimizing the danger, and substantially reducing the initial outlay of capital as well as thereby reducing cost of production It is claimed that the product so obtained is superior to that made by the old process.

Motion Picture Films—How Long Will They Last?—From time to time we hear of the sealing up of motion picture films to be saved for the benefit of future historians, and the natural question always asked is, "How long will they last?" One answer to this is given in a partly facetious note in *Eng and Min Jour Press* under the caption of, 'Outdoing King Tut" A Chicago film manufacturer is preparing a collection of motion picture films, visualizing mining and other industries for presentation to the Smithsonian Institution for preservation Of his technical staff this manufacturer asked the same question, and was informed that they would last anywhere from 10,000 to 50,000 years. The vault in which they are sealed must not according to stipulation, be unsealed for at least 5 000 years

Highway Advertising Signs are being done away with in England where some of the principal business interests decided to withdraw their signs from the countryside in sympathy with the movement for the preservation of the natural beauty of the landscape The example was set by a very large distributor of petroleum products This company came to the belief or rather a realization of the fact, that these immense advertising signs were doing them more harm than good in that motorists who were the logical consumers of their petrol were being forced while touring to view the landscape through a sort of low visibility screen of their advertising and so were unconsciously building up an antipathy complex against the advertiser This good example was soon followed by others who no longer were able to set up the defense that "others were doing it"

Uncertain Oil.—As the American people have too recently learned oil seems to belong to the one who gets it An interesting situation is described in *The Lamp*, a house organ of the Standard Oil Co of N J, wherein the ownership of the oil from a certain well was contingent on the fluctuation of level of a lake The enthusiasm developed in Venezuela a year ago over a well that flowed as much as 100,000 barrels in a single day resulted in several curiosities in drilling The great well itself, after filling the neighboring swamps and covering the nearby surface of Lake Maracaibo for a radius of several miles with a scum of oil sanded up and had to be abandoned The waters of the Lake adjoining the concession on which the big well was located were covered by a concession that extended to the water's edge Under the terms of the concession any well drilled must be under water but there was no restriction as to the location of the rig. Consequently, the derrick stands with two of its foundations knee deep in Lake Maracaibo but the bulk of the rig is on dry land where the drilling rights belong to a different concessionaire So long as the fresh waters continue to lap against the casing the title to the oil will remain unquestioned, but should there be a few inches drop in the level of Lake Maracaibo a serious problem may arise

Getting Heat From the Center of the Earth is impracticable, according to the Bureau of Mines. In descending beneath the surface of the earth the temperature increases continuously with depth at a rate varying from one degree Fahrenheit for 70 feet in depth to one degree in 250 feet, according to the region where it has been measured. Men have ascended over five miles above the surface of the earth. If they could go five miles below the surface in a shaft that deep a region of high temperature would



be reached, and it would seem as though it ought to be possible to utilize that heat as a source of power, free and perpetual. The principal difficulty is not the cost of penetrating to so great a depth (though a shaft 5 miles deep would cost $5,000,000 or more), but the fact that the amount of heat that can be derived from hot rock is not proportional to its temperature, but is limited by the conductivity of the rock. Comparing the heat with water filtering through porous rock, it is evident that the amount of water that can get through in a given time is not dependent upon the amount of water available, or even on its pressure, but depends chiefly on the porosity of the rock. The heat conductivity of rock is low, and in order to get any considerable quantity of heat through in a unit of time the area of surface exposed must be large. The second important difficulty depends on space, the heat is available five miles below the surface but it can only be usefully employed on the surface and how to get it there without losing most of it on the way is the problem. One suggestion is to pass water down, and circulate it through large galleries at the bottom, thus giving it time to take up the heat, even at the slow rate of transfer that exists. This would give us water at a high temperature and pressure, but at the bottom of the shaft, where it is no more useful than ice is in the polar regions. In rising to the top of the shaft, the hot water would cool down at about the same rate as it heated up in descending. Even with extremely efficient (and expensive) heat insulation on the up going pipe, so much of the heat would be lost that what remained would not pay for the cost of getting it, at least until coal and other sources of power are much more expensive than they are now.

Industrial Progress

New Process for Obtaining Low-Ash Coking Coal.—Almost all coking coal districts contain large quantities of coking coal of higher grade than any heretofore available for making low ash metallurgic coke. This low ash coal exists in coal beds of both good and poor quality and is scattered through the coal in masses from ¼ inch up to 1, 2, 3 or 4 inches in diameter. There is no visible distinction between these masses of pure coal and impure coal. As the specific gravity of each piece of coal depends upon the quantity of ash present in that piece, the differences in specific gravity can be used for separating the low ash and high ash coal. The specific gravity increases about .01 for each per cent of ash. If separation be made by a "float and sink" method by introducing the coal into a liquid of the desired specific gravity, as for example 1.36 all the coal having a specific gravity less than 1.36 will float and all the coal having a greater specific gravity will sink. An exact separation thus can be made dividing the coal into two grades. Solutions of high gravity and liquids can be used for making such separations experimentally but not commercially. However, the sand flotation process can be used by which a liquid of any desired specific gravity can be produced and utilized to make such separations. The sand flotation process utilizes an agitated mixture of sand, or other suitable material and water as a "fluid mass" of relatively high specific gravity. The sand is kept in suspension in the water by controllable means for providing agitation and readily can be maintained at any desired specific gravity. The specific gravity is under close control and can be varied accurately at will. This process was introduced in the anthracite districts of Pennsylvania two years ago. There now are six plants in operation and another soon will be completed.—*Iron Trade*, 74 3, 1p.

Disposal of Creamery Wastes by the activated sludge method has proved satisfactory in laboratory experiments at Iowa State College, Ames, Iowa, made by Dr. Max Levine. A creamery waste differs markedly from ordinary sewage in many respects but particularly in that it contains the carbohydrate lactrose which rapidly undergoes acid fermentation, thereby rendering the waste extremely refractory to septic tank treatment. Ordinary digestion of creamery wastes develops so much acid that the regular regime of a septic or Imhoff tank is entirely upset if the creamery volume is at all a considerable portion of the sewage. The right kind of digesting bacteria cannot grow on acid media, they thrive in a slightly alkaline medium. Observations were made on the effect of aeration of various concentrations of skim milk and of buttermilk with respect to changes in oxygen requirement, nitrogenous matter, turbidity, relative stability and removal of solid constituents. An activated sludge may be developed in about two weeks from 2 per cent skim milk. Aeration of 2 per cent skim milk for 16 to 25 hours in bottles or in barrels (with 20 per cent activated sludge and 50 to 60 cu. ft. of air per gallon) effected marked reductions in turbidity, acidity, total solids, organic nitrogen and, particularly, oxygen consumed and demand. Reductions of 95 to 99 per cent in the oxygen requirements were generally obtained.—*Eng. News-Record*, 92 4, 1 p.

Rubber Flooring is, according to a writer in *India Rubber World* (69 5, 2 pp., ill.), destined to become as general as rubber heels. The development of less than three years in the production of multiple colored, reinforced rubber flooring, in which the cotton fiber has been reduced to the merest tissue and vulcanized under high pressure, has convinced many persons as to its desirability in many different classes of buildings. Its supplementary use for wainscoting, bases, surbases, stair treads, and other purposes is also being developed satisfactorily. Reinforced rubber flooring combines the ideal features in all types of flooring with none of the disadvantages. It has no drawback except that the first cost is somewhat higher than other types of floor which are necessarily temporary in character. Reinforced rubber properly applied will last as long as the house. This country will be using reinforced rubber flooring at an annual rate far in excess of 100,000,000 square feet within ten years.

Making Metal Patterns by Electro Deposition.—This method is perhaps the one big advance step made in the producing of metal patterns in the last twenty five years. Casts of wax, plaster of paris, or any fusible alloy are taken of the pattern to be reproduced. These casts are made of conductive material on the impression surfaces. In the case of wax or plaster of paris, graphite is used to make the conductive surface. Contact wires are inserted in the casts to make a connection in the plating tank and conductive surface of the cast. Suitable insulation is given these casts to prevent the metal from spreading on the non-conductive surfaces. These casts are then placed in the desired plating solutions, and are allowed to run until the desired thickness is obtained. The casts are taken from the bath and the metal deposits removed. They are backed up by some suitable alloy, such as white metal to give strength, if necessary. The partings are then checked very closely and machined or ground off if required, and from this point the procedure is identical with the old method. The method is so sensitive that it will reproduce the finest hair line. It is possible to ascertain whether the patterns are made from a mahogany, pine, or metal original, as in mahogany, the grain of the wood can be clearly seen on the finished article. Center lines on wood or metal patterns to be reproduced show up very plainly. This method is fast being adopted by many of the large automobile manufacturers in the United States, due to the high degree of accuracy obtained in producing duplicate metal patterns, as well as the comparatively low cost.—*Metal Ind.*, 24 3, 1 p., ill.

A New Burner for Refineries has been placed on the market, in which there are two separate pipes. The steam enters through the upper pipe and the oil through the lower. In the mixing chamber the oil rises to about the base of the cup. As a result of the whirling motion given to the steam, which expands over the curved surfaces in a manner similar to the expansion which occurs in a steam turbine, the oil and steam become intimately mixed and fill the entire chamber. The mixing chamber serves as a reservoir and tends to prevent the sudden changes in the size of the flame which are apt to result from fluctuations in oil or steam pressure. This action is comparable to the action of an air chamber on a pump in steadying the discharge pressure. The oil may be fed by pressure or gravity. As low as 20 pounds per square inch steam pressure will effect complete atomization of the oil.

The New High-Pressure Steam Boilers have introduced a number of new considerations. Evidently, thinks the *Iron Age*, any uncertainty regarding the ability of materials used for valves, boilers, piping, turbines, etc., to withstand the stress of steam pressures up to 1200 lbs. per square inch, has disappeared. The problem now is to determine operating pressures that will assure the minimum cost of power for steam temperatures not exceeding 750 deg. Fahr., this point being described as the absolute limit with present materials. The problem was discussed in

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two papers, one by W J. Wohlenberg, assistant professor of mechanical engineering at Yale University, and the other jointly by C. F Hirshfeld, chief of the research department of the Detroit Edison Co., and F. O Ellenwood, professor of heat power engineering at Cornell University Mr Wohlenberg finds that the thermal efficiency of a generating station falls off beyond a pressure of 1000 lbs. per square inch, while Hirshfeld and Ellenwood conclude that this efficiency shows continuous improvement beyond 1200 lbs. per square inch, which was the highest pressure for which they made their calculations Taking into account investment charges, maintenance and fuel charges the authors show that the maximum commercial efficiency is obtained at a pressure of 900 lbs per square inch, using coal costing $5 a ton and at a pressure of 1000 lbs per square inch with coal at $8 a ton Apparently little is gained beyond pressures of 500 lbs per square inch when coal cost $5 a ton, or 700 lbs per square inch when the cost of coal is $8 a ton

Economic Waste is successfully being warred against by the Department of Commerce There have been altogether too many sizes, shapes and grades of a thousand-and one different manufactured products Common sense indicates that in the majority of these cases the buyer would be as well satisfied if he had a score of sizes of, say bedsprings or of paving bricks to choose from instead of that many sizes made by each manufacturer, with each manufacturer's sizes all different in some degree from those of other manufacturers of the same product. For this bad situation no one is to be blamed but it was recognized that if they could be brought to a common agreement by some disinterested outside agency an immense amount of economic waste would be eliminated This work of the Department of Commerce has been going on for quite a time and has permeated scores of special industries Most manufacturers have been only too glad to weed out odd sizes, etc, of their product, since the general reform assures them that their competitors will not profit unduly by the weeding out. Of course this work results in a sort of standardization, and while one man may regret, for instance, that the peculiar variety of machine screw that he has been using has been dropped, the majority will be pleased because they will find that there is a better future chance of matching the size, thread etc they want. About 80 per cent of most products have been dropped The work has gone on quietly and without great notice outside of the technical press, but it has received considerable notice in the latter If the actual saving of material and human effort brought about by this reform could be made in some other manner that would be more dramatic it would be emblazoned on the front page of every newspaper in the country

A New Non Corrosive Pipe-Lining Process.—Some attention is being given in Britain to a system whereby cast iron and steel water pipes can be lined with concrete to prevent that corrosion which has always proved such a trouble in the past. These pipes are being manufactured by the Hume centrifugal process whereby the pipes are formed in revolving moulds. Experiments made proved that concrete would adhere permanently to a polished and oiled surface The process is carried out as follows portland cement and crushed granite are the materials used When ready it is conveyed to troughs which lie alongside each of the centrifugal machines used for the actual manufacture of the concrete lined pipes Rings are placed at each end inside the pipe to retain the concrete in place, otherwise as soon as the pipes started to revolve, some of it would be ejected at each end A slow rotary movement is then given to the pipe and is continued for ten minutes or so, and, while this is going on sand and cement are introduced at each end The concrete mixture adheres to the internal surface of the pipe by centrifugal force and as soon as sufficient material has been introduced, a hand tool being used to get the mixture along the pipe the speed of rotation is considerably increased resulting in the coarser parts of the concrete being made to close up to the surface of the pipe whilst it also results in the liquid in the concrete being slowly evacuated from its body The liquid really forms a thin film on the surface of the concrete but as soon as the pipe stops spinning this film falls to the bottom and can be brushed out when the internal

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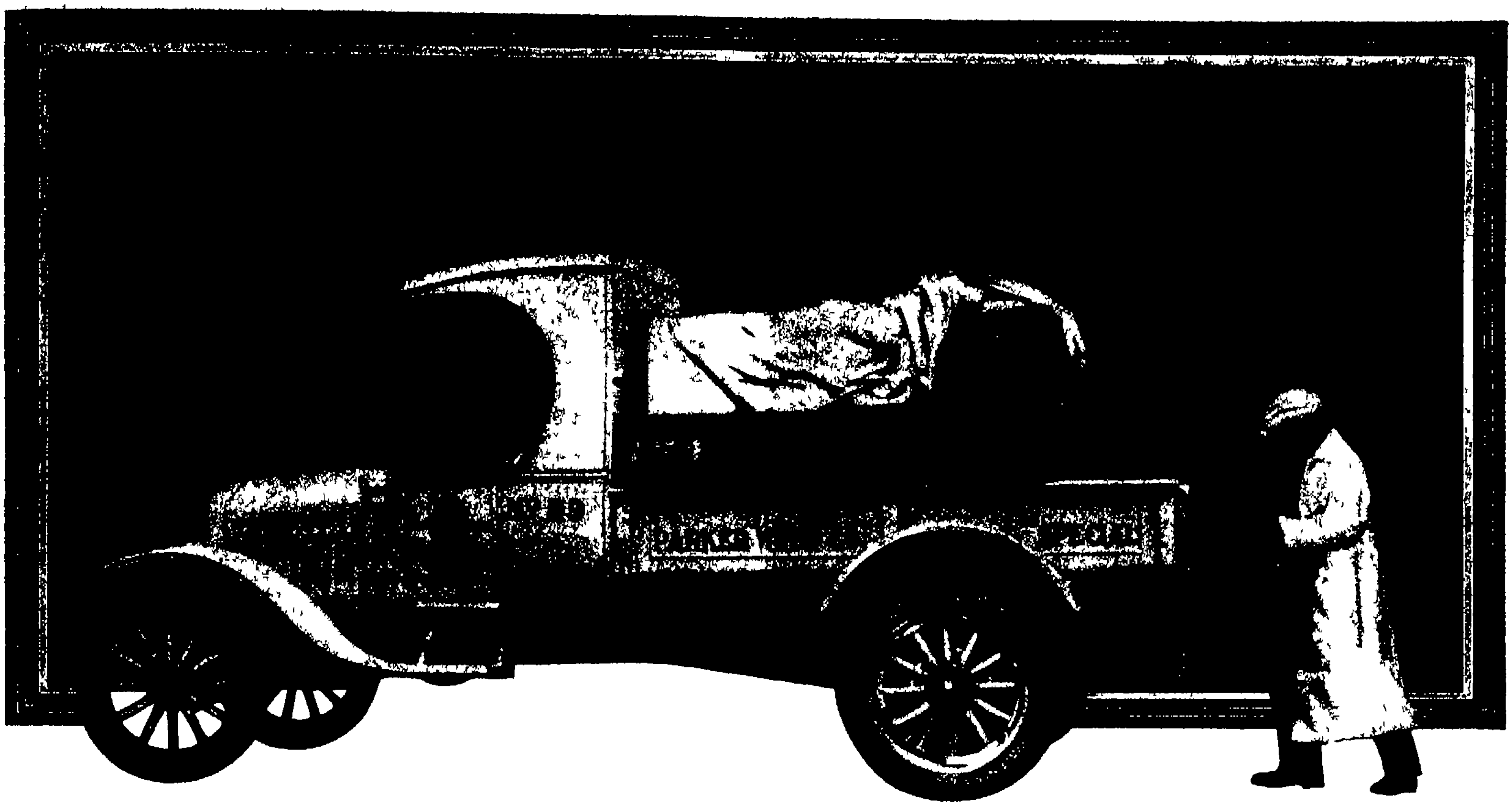

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rings at the ends of the pipe are removed. When the concrete is set the pipes are put away for three or four weeks, at the end of which time they are reckoned to be ready for use Most of these pipes are made with a lining of one-half inch concrete but if required, this can be increased to one inch or more —*Cement and Eng News*, 36 1, p. 47

Coal Processing had a banner year in 1923, according to an editorial in *Chem. and Metall Eng*, (30 .8) Especially is this true of the manufacture of water gas, in which there has been a widespread recognition and general adoption of the "backrun gas' process. This system of making gas permits the use of bituminous coal in the water-gas generator and requires less oil for carburetion Along with these benefits, the heat losses are decreased as compared with those of the standard water-gas set, and the deposit of carbon on the checkerwork of superheater and carbureter is prevented. In the field of byproduct coking the outstanding feature of the year is one that holds great promise for the industry The Becker design of coke oven (Koppers patents) proved so successful as practically to supersede all other types in the contracts let for new construction This oven was first brought to the attention of the field in 1922, when an experimental plant of five ovens was erected at Chicago This oven has proved to be a great advance in the art and has lessened the time required for coking sufficiently to decrease greatly the capital charges against coke and has at the same time extended the range of coals available for coking, as it will coke coals heretofore uncokable

Liquid Chlorine is Fast Replacing Bleaching Powder, according to a writer in *Chem and Metall Eng*, (30 8) No branch of the heavy chemical industry has undergone such radical changes in the past two or three years as the electrolytic manufacture of alkali. The year 1923 saw the largest step yet taken in the replacement of bleaching powder which is known commercially as bleach," by liquid chlorine It is safe to say that in 85 to 90 per cent of all places where bleaching powder was or is used it can be replaced by liquid chlorine and show a material saving In 1918 the liquid chlorine capacity of this country was about 7900 tons per year (equivalent to approximately 23 700 tons of bleach), the large percentage of chlorine then going into bleaching powder Jan 1, 1924, the liquid chlorine capacity of this country was approximately 33 000 tons per year (equivalent to 99 000 tons of bleach), which shows the increasing consumption of liquid chlorine in replacing bleaching powder

Oxygen by the Liquefaction Process.—Very few of the large industrial users of oxygen in this country have owned plants for producing the oxygen they require, because the economic use of the electrolytic process involved the disposal of the hydrogen simultaneously generated and until very recently there was no satisfactory liquefaction unit available. Within the past two years, however, there has been placed in successful operation in more than thirty plants a liquefaction system that should be of great interest to all large users In outline, the process, is exceedingly simple Air is freed from carbon dioxide and suspended matter in caustic potash scrubbing towers, brought to high pressure in a multi-stage compressor, dried by solid caustic potash while still under pressure liquefied by sudden expansion and oxygen separated by fractional distillation of the liquid air —*Chem and Metall Eng.*, 30 5, 4 pp, ill

Simplification of Manufactured Products in general is being brought about through efforts of the Department of Commerce This is simply an effort to reduce economic waste An excellent patient of this sort on which to operate is cited by *Automotive Industries* One prominent make of six-cylinder passenger car uses 7 sizes of carriage bolts, 16 sizes of cotter pins, 5 sizes of Whitney keys, 19 sizes of rivets, 98 sizes and types of machine screws and 57 sizes of wood screws in body work.

Floating Roof Tanks.—The petroleum industry has recently shown such great interest in the prevention of evaporation losses from crude oil and gasoline that almost daily there is being developed and placed on the market equipment designed especially to reduce these losses, states Ludwig Schmidt, assistant petroleum engineer, Department of the Interior, in Serial 2547, recently issued by the Bureau of Mines. Among the recent developments is a new type of tank roof known as the "floating roof," which practically eliminates the vapor space over the surface of the oil, thus removing one of the chief causes of evaporation. There are at present at least two types of floating roofs, which, while similar in fundamental principle, differ mainly in the method of making contact with the inside shell of the tank. One type of floating roof is known as a floating tank deck, and has on its circumference flexible metal baskets containing gravel that rest against the inside shell of the tank. In the other type of floating roof contact with the tank shell is made by the use of movable buffers or shoes. These are attached to the outer ring of the roof and are pressed against the tank shell by means of springs. The primary function of the floating roof is to reduce evaporation losses by eliminating the vapor space above the oil, thus preventing breathing losses and losses due to circulation of air over the liquid. By elimination of the vapor space the fire hazard is also reduced in that there is no large confined space filled with explosive vapor, nor is there any large body of liquid exposed to the air With this type of construction the exposed liquid is in a very narrow slot of sufficient depth to prevent free circulation of the air which is necessary to support combustion. Floating roof tanks have been illustrated in recent issues of the SCIENTIFIC AMERICAN.

Cerium is usually regarded as belonging to the general group of rare earths, as it invariably occurs in nature associated with the other members of the group, and is very similar to the other rare-earth elements in many of its chemical properties, states J P. Bonardi, in Bulletin 212, recently issued by the Department of Interior, through the Bureau of Mines. Cerium is now obtained mostly from monazite and from monazite sands. The mineral monazite occurs in Norway, in Ural Mountains in North and South Carolina, and in Canada The disintegration product from the mineral called monazite sand is fine gravel or sand, and occurs in river banks and on the seashore, principally in Brazil, North and South Carolina, Australia, the Ural Mountains and in the State of Travancore, southern India The monazite content varies from a trace up to 4 per cent. so that some method of concentration must be employed, such as washing by placer methods, wet table concentration, or magnetic separation The most important use for cerium is in the manufacture of gas mantles for incandescent lighting Cerium is also utilized in combination with other cerium earths—in pyrophoric alloys, and for tracer" shells and bullets. Alloys of mixed cerium—earth metals are used as reducing agents to produce metals from metallic oxides. A mixture of about 35 per cent iron and 65 per cent cerium is used for automatic lighters. Various combinations of various metals with cerium have been patented for use in pyrophoric alloys It is claimed that the addition of 0 2 per cent of cerium metal to aluminum definitely improves its physical properties.

Duriron is generally known as an acid-resisting material, but its wide range of applications to various industries is not universally appreciated Duriron valves, cocks, piping, pumps, exhaust fans and containers are used for the handling and storage of muriatic, nitric, sulphuric, phosphoric and other acids used in the cleaning or coloring of brass. The alloy is entirely resistant to the action of sulphuric, nitric and phosphoric acids of any strength or temperature, and so slightly affected by muriatic that it is entirely practical for handling and satisfactory for commercial uses Duriron is produced in many forms and while it is too hard to machine by ordinary methods, grinding machinery has been devised so the material may be fabricated into special equipment or parts for standard machinery subject to corrosion A great advantage in the use of Duriron is its well nigh universal acid resistance. A wide use has been found for Duriron anodes, both for use in metal refining and recently as an insoluble anode for increasing current density in plating operations, and for various other metallurgical purposes. It is also produced in great volumes in the form of standard drain pipe and fittings which are particularly adapted to handling corrosive wastes. This drain pipe is installed exactly the same and as easily as cast iron. Duriron tank outlets and connections, circulating steam jets and similar equipment for pickling and plating are widely used. In short, Duriron is paid up insurance against loss and depreciation wherever acids are used [illegible].—*Brass World*, 20:1, note.

Lead exempts you from a weather tax

HOW much is your weather tax? Thousands of owners in the United States pay such a tax for the share of rain, snow, and sunshine that fall on their properties

One billion dollars' worth of property crumbles beyond repair in this country each year And this vast total includes the many millions paid by property owners as weather tax—money that lead would help to save

Lead exempts you from a weather tax

Lead is the ugly duckling among metals It isn't so handsome as gold It isn't so strong as iron Yet lead performs many functions—for which the other metals are not suitable In the form of white-lead in paint it is man's mightiest protector of wooden and non-metallic surfaces

Paint manufacturers use white-lead to make their best paints Painters apply white-lead paint as a protection and a decoration on buildings you see everywhere

Approximately 350,000,000 pounds of white-lead are used every year in this country This makes enough paint to cover with one coat about 3,000,000 houses of average size On the outside and the inside of homes, churches, schools, barns, theatres and stores, white-lead foils the attempts of sun, air, and moisture to collect a weather tax

Where man pays the tax

But the weather still collects some of its toll Frequently you see a home that once was fresh and new, but now is rotting away The porch floor is not safe Window sashes are rotting The sides of the house are weatherbeaten and worn On inside walls are great damp spots where moisture has penetrated

White-lead would have prolonged the life of the house It would have been an impassable barrier to air and moisture As long as its film was unbroken it would have kept the covered surface safe

And after all, the first cost of white-lead paint is small when you consider how such paint protects your home your property, and the money you invested in it

White-lead a standard covering

From the days of our forefathers, white-lead has been the standard for preventing decay and deterioration and for pro-

Rain and storm have attacked this pillar, which was unprotected by paint The owner is estimating the size of his weather tax

viding the desired decoration Wise property owners everywhere are obeying the rule, "Save the surface and you save all," and are covering the surface with white lead paint Thus they avoid paying weather and repair taxes

For exterior painting they find that white-lead and pure linseed oil make a paint that sticks tight to the surface, is impervious to moisture, and lasts long And they know that fresh-looking, well-kept property is an asset to the community, a sign of cleanliness and respectability within

For interior painting of walls and woodwork these owners find that white lead mixed with flatting oil not only protects the surface but also gives a soft, beautiful finish, restful and pleasing to the eye By mixing coloring matter with white-lead they obtain the color that will harmonize perfectly with any decorative scheme

Producers of lead products

National Lead Company makes lead products for practically every purpose to which lead can be put in art, industry and daily life

Dutch Boy white-lead is the name of the pure white-lead made and sold by National Lead Company It is extremely fine—so fine that it easily flows through a silk screen containing 27 000 holes to the square inch This gives opacity and smoothness of film

On every keg of *Dutch Boy white lead* is reproduced the picture of the Dutch Boy Painter shown below This trademark guarantees a product of the highest quality Dutch Boy products also include red-lead, linseed oil, flatting oil, babbitt metals, and solder

Send for this painting portfolio

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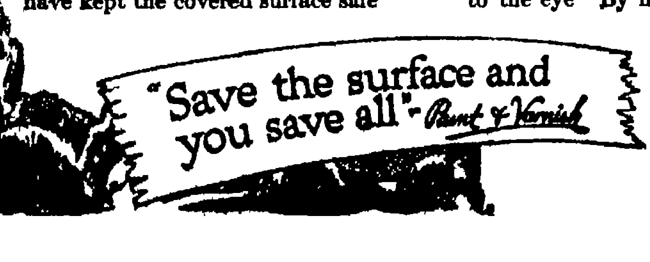
Besides its use in paint, lead has many other interesting uses In fact, the story of lead is a fascinating one, and if you want to know more about this wonder metal, we can recommend a number of interesting books The latest and probably the most complete story of lead and its many uses is "Lead, the Precious Metal," published by the Century Company, New York If you are unable to get it at your bookstore, write us or the publishers



NATIONAL LEAD COMPANY

New York, 111 Broadway Boston, 131 State St Buffalo, 116 Oak St. Chicago, 900 West 18th St Cincinnati, 659 Freeman Ave Cleveland 820 West Superior Ave St. Louis, 722 Chestnut St San Francisco, 485 California St; Pittsburgh National Lead & Oil Co. of Pa 316 Fourth Avenue; Philadelphia, John T Lewis & Bros. Co. 437 Chestnut Street

Our Abrams Investigation—VII.

(*Continued from page 240*)

he experiences the reactions. If he is working with a known blood specimen—one which is accompanied by a case history or one which has been taken from the patient in person—the reactions are usually strong and readily detected by the diagnostician Hence his findings are definite and quickly arrived at, in marked contrast to the weak and un certain reactions when a 'blind' specimen is being tested, especially under rigid test conditions

We have in this procedure all the elements of the familiar ouija board experiment, in which two persons quite unconsciously push a tiny pointer over the letters on a large board, spelling queer messages which have their origin in the subconscious minds of one or both sitters The E R. A practi tioner has been taught that at the bottom of all ailments there is a basic toxemia, orig inally called congenital syphilis but since changed to the more euphonious and less harsh name of 'diminished resistance' or D R for short Then, too he has been taught that tuberculosis carcinoma sarcoma and other troubles are far from rare If not developed to a point where they may be de tected by ordinary clinical diagnosis he is told, they are usually present nevertheless in an incipient stage Furthermore, so runs the story, the electronic diagnosis is so much more sensitive and accurate than the clini cal, that these things are detected from the electronic reactions long before their pres ence would be made known by the more usual technique The mere fact that a thorough clinical examination including X ray ex ploration the Wasserman test and other pro cedures in which modern medicine places much faith fails in many instances to check up with the E R A findings means noth ing whatever save discredit to the orthodox doctor E R A its protagonists insist, must be correct clinical findings that diverge must be wrong Which is mildly amusing in view of the fact that, in his original identifica tion of his rates Abrams relied upon clini cal diagnosis wholly obviously no other course was open

The writer can hear a storm of protest from E R A ranks against these statements Even though the E R A gentry have done absolutely nothing for our Committee in the way of submitting their technique to simple tests though repeatedly urged to do so by their leaders they are always ready to take exception to whatever opinions we may form in the absence of their cooperation They demand that we accept E R. A claims with out proof Still even though they have pre ferred so far not to undergo our tests we have been going ahead with excellent results.

Our observation and tests with regard to the subjective nature of the reactions have been interesting and, so far convincing Nor are we alone in the viewpoint to which they have led us Not so long ago a prominent electrical manufacturer was asked to make a sample resistance box according to cer tain specifications for an Abrams practi tioner The order was filled and in view of all the circumstances a very competent engineer of the company was designated to see the box installed and tried out He took the liberty of removing essential parts of the internal mechanism of the box without informing the 'doctor' The box was never theless placed in the electronic circuit and the reactions obtained through it with all accustomed clarity The engineer went fur ther, and disconnected some of the external connections but the reactions were in no whit embarrassed So much cannot be said for the Abrams practitioner when he learned what had been done however

If this happened to you or to me, we should seriously question the technique under which such a damning thing could happen Well the E. R A man in the case may have questioned but if he did he didn t question out loud His sole visible response was to try to get the engineer to promise never to tell anybody about it. And he is still diag nosing with the electronic apparatus, and without apology Waiving this rather obvi ous and important matter of the doctor's good faith however, when the vibratory rates come through an empty box and open con nections, one must wonder whether the whole technique means anything, after all

Then we have the case of an engineer who has given a great deal of attention to the physical side of the electronic technique He has worked out elaborate diagnostic equip ment which, on its very face, must com mand deep admiration We who have worked with delicate radio equipment, even to sensi tive and highly accurate wave-meters, know

precision apparatus when it is placed before us. Then, to cap the climax, we were shown a number of curves of various diseases, carefully plotted on quadrilled paper with the same precision as a wave-length curve for a variable condenser or other piece of radio equipment. Could it be that we were getting down to this marvellous simplicity in medicine, when every disease would be measured and recorded, its wave length established in centimeters? Already we had visions of the future doctor—a studious young man with a collection of good looking apparatus and a heavy loose leaf note book as his main stock in trade manipulating the apparatus and referring to his wave length charts, and finally giving us a detailed diagnosis of even our most minute irregularities such as the most skilled diagnostician of the old school could not do in a thousand years

"How were these remarkable curves obtained? we asked To which was the reply "Well you see, for the time being we make use of a human reagent—the Abrams technique you know—but only for the time being We are to have a substitute for the human reagent ' We asked if we might see these curves in the making 'Certainly came the cheerful reply "Arrangements have been made to run through a typical test this evening One of the most skilled Abrams diagnosticians will elicit the reactions

Several hours later we were ushered into a small room in an office building occupied mainly by doctors, and introduced under an assumed name to an elderly practitioner We shall not mention the city nor give any details which might disclose the participants in this particular test for nothing is served by giving names when we are primarily interested in the technique itself and not in the individuals, *per se* The elaborate equipment was rapidly assembled for the test A young lady was to serve as the reagent To give the procedure the earmarks of a scientific demonstration a temporary screen was placed between the doctor and the engineer manipulating the instruments

Soon the test got under way A pure germ culture of typhoid was to be measured for the purpose of plotting the typhoid curve though E R. A has already admitted the impossibility of identifying pure germ cultures' The engineer would adjust the wave length device then determine the potential of the reactions for that wave length before going on to the next wave length setting and so on In this manner so the theory goes a number of points would be obtained based on the potential for each wave length setting thus giving the gradual swing of the curve up to the peak, and down again on the other side

The procedure was not very impressive Several hours of precious time were used up Finally the writer asked if he might manipulate the apparatus The request was immediately granted Then sitting behind the screen the writer s first move was to disconnect one of the wires This, evidently made no difference The doctor pronounced a good strong reaction, just the same The engineer rushed into the breach with an explanation It makes no difference he informed us whether the wire connections are disturbed or not the electronic energy jumps across wide gaps with the greatest ease One s first impulse would be to ask why have the elaborate apparatus, if this is the case but in point of fact there is an even more serious aspect than this

In this particular set up the potential or quantity of the disease is measured not in ohms," but in centimeters An adjustable gap is provided in the wiring, and, starting from actual contact this is widened until the reactions cease to be felt by the operator who is at work *on the reagent.* Width of the gap which stops the passage of the energy is then taken as the measure of the energy's intensity and this gap is in no case more than about two feet—usually much less It is very surprising, after this, to be told that the apparatus may be disconnected and an additional gap of four or five feet introduced without any effect whatever upon the readings. This, however, is quite consistent with the extraordinary facility of the electronic practitioners in devising explanations that are, when analysed, more absurd than the irregularities which they seek to explain

Our next move then, was something less apt to be circumvented by the eccentricities of the electronic forces. Without the doctor's knowledge, we picked up a test tube containing a brown gelatinous matter quite similar in appearance to the contents of the tube resting in the diagnostic slide. We asked the doctor if the reactions were still present. The answer was in the affirmative. And why shouldn't they be? The specimen was

still in place Then we handed the extra specimen to the engineer, who was sitting in plain view of the diagnostician, with the remark that we were interested in timing the "lag" in the reactions. Nothing was said to the doctor, but he could see the passing of the specimen back and forth. After ten seconds of stroking, the diagnostician announced that the reactions were "off." This was rather interesting, since the original typhoid specimen was all the while in the diagnostic slide. We asked the engineer for the extra specimen, and acted as though it were being placed on the apparatus. About eight seconds later, we were told that the reactions were back again Not satisfied with this much we handed the extra specimen back to the engineer Twelve seconds later we were told that the reactions were gone Upon taking back the specimen the reactions returned in some ten seconds. All the while the original typhoid specimen had been left in place.

Here we have a splendid case of suggestion, controlling the involuntary muscular action of the stroking procedure That the diagnostician in question was sincere, we have not the slightest doubt. That his subconscious mind directed his hand so that the "reactions" were gone when the specimen was apparently removed from the slide, and again caused the "reactions" when the specimen was apparently back in place, there seems no doubt in our mind.

Here was a clean-cut case of suggestion Of course our engineer friend made the customary electronic explanations and apologies He explained that such a thing was bound to happen because the doctor wanted to make no mistakes Perhaps, all the while the reactions were functioning correctly but they might have been wrongly reported by the doctor because he was anxious to make no mistakes And so on true to electronic style The fact remains that there cannot be much real engineering work involved in a technique that is so uncertain and unstable as to be led astray by our simple maneuver

Then there is an electronic worker—a non E R. A worker if you please and proud of the fact—who volunteered to lead us out of the dark jungle of E R A and into the open spaces, where we could get at the fundamentals and truth of real electronic medicine without further waste of time Although it meant a long journey we finally visited this gentleman and were rewarded by spending a pleasant day in his clinic and laboratory

In the morning we started at the beginning of the subject We were given demonstrations in which a little copper globe was made to spin about in a magnetic field under the influence of a powerful light The relative efficiency of a crude spark coil current and a Tesla-coil current when applied to a geissler tube was another feature on the bill Peculiarities of sound waves served to pass an entertaining half hour By easy stages we got to the crux of the matter—the all important abdomen rubbing

Did you ever see the reactions?" we were asked "No Many E R A men have endeavored to demonstrate them to us, but so far we have never seen or felt them," was our sincere answer 'Well," said our guide in the great electronic field 'I am going to let you feel them so that you will be sure of it. I am going to elicit such strong reactions that the rod will be stuck fast to the reagent and will be pulled right out of your hand"

What a beautiful promise Could it be, after all, that all our E R. A mentors, so far were mere tyros at this work?

In the reagent's hand was placed a small glass tube, containing a human embryo just 21 days old according to the label "This little fellow throws off a male reaction despite the fact he's dried up, petrified, if you wish, and surrounded by glass walls," was the preliminary announcement to this test. Then the doctor proceeded to rub the abdomen of the reagent with an amber-colored glass rod, first on the left side and then on the right. The rod, suddenly, began to stick on the right side—the male reaction area, according to the simon pure Abrams doctrine. The rod would move down over the skin, suddenly stopping at a given point, and then resume its smooth glide to the end of the stroke Then we tried it. Somehow or other, the rod refused to stick for us. We tried and tried and tried some more. Each time holding the rod in a different manner so as to secure the most delicate balancing of the rod to ensure the detection of the slightest change in the "pull" or "feel"

Meanwhile, there were present an E. R. A. (genuine) doctor and an electrical man doing development work for our host. Seeing

our difficulties, both these gentlemen took the rod in due turn and proceeded to get the same results as our host. The rod stuck for them, but refused to stick for us. Other specimens were tried—neo salvarsan, which should give the syphilis reaction good and strong, according to our guide's pronouncement, and a piece of cancerous tissue Again the others present had no trouble in getting the reactions, while we scored an ignominious failure, finally bringing censure on our heads. Suddenly, the host exclaimed that the cancer area was blanching "Look! See that crescent shaped patch? It's the cancer area. That is a beautiful demonstration, the best I have ever seen Do you see it?" Frankly, we did not. The skin of the reagent was rather pale all over, and almost uniform throughout We did not see any crescent shaped patch although our host and the two other men present said they saw it and became quite enthusiastic over the fact

The reactions were not so successful Hence by common consent we turned our attentions to a study of the diagnostic apparatus and the treatment machine Here again we found an attempt to introduce real engineering into the so called electronic equipment The diagnostic outfit was a business like piece of work, while the treatment machine was quite capable of delivering some very real energy in the form of high frequency current produced by an oscillating vacuum tube The precision with which the oscillator could be tuned so as to cause a maximum deflection on the hot wire meter of the portable diagnostic outfit for any given disc setting was of interest to our electrical type of mind It indicated exceedingly sharp tuning. But as to the value of the diagnostic and treatment machines from the standpoint of suffering humanity we could not pass an opinion Suffice it to state that all the while we had visions of those elusive reactions on which the entire structure here, as elsewhere rests.

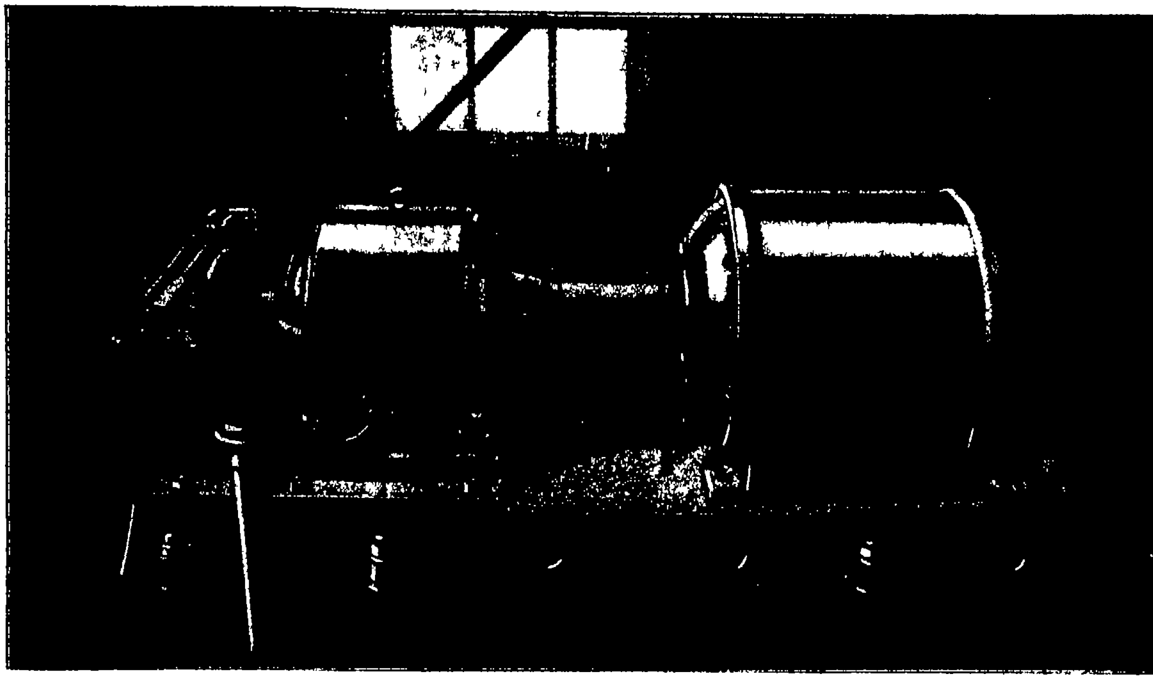
At the present writing we have under way a series of tests with a recognized body of competent electronic workers While the members of this body have taken the Abrams course and are provided with genuine Abrams apparatus, they are not and will not call themselves E R. A men The tests have for their main object the checking up of E R. A diagnoses on blood specimens taken at the same time from the same patients with a view to seeing whether it is possible by means of this method to get the same readings for precisely the same blood specimens Surely nothing could be simpler or fairer If we are to believe in the accuracy of E R. A findings then it is reasonable to assume that the same blood specimens taken at the same time should give the same E R A readings In this manner we meet the objection to making comparisons with clinical findings which, our readers will recall, are only 40 per cent accurate according to E R A verdict while E R. A findings, based on the same verdict, are 75 to 90 per cent correct The results of these tests will be published at an early date The tests will extend over a considerable period and will be of the most exhaustive character Every opportunity will be given to the E. R. A method to give proof of its most elementary basis in cold fact

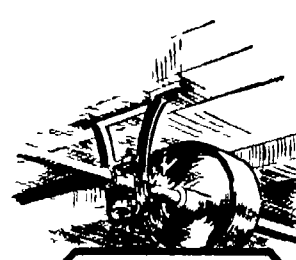
Meanwhile, we again extend our invitation to all members of the electronic fraternity to cooperate with us, to the end that we may get at the truth of this great controversy The cooperation we seek is only such as the world expects from any serious and sincere body of men who are anxious to prove their case once and for all Never again will E. R. A and electronic medicine have this opportunity of securing a fair and sympathetic hearing So far the cooperation has been conspicuous by its absence, and for that reason our committee has been obliged to proceed quite unaided and, true to tell, it has arrived at certain tentative conclusions which are not favorable to the electronic fraternity Still, those conclusions, being purely tentative, are subject to change should the proper evidence be presented

The Mooring Mast is the Thing

(Continued from page 221)

The tearing loose of "Shenandoah' due to a sudden dynamic stress suggests that we may go to the sea for another suggestion To ease a sudden strain in the towing cables powerful tugs make use of towing winches These allow the cable to pay out when the pull exceeds a certain limit taking it up when the strain eases up. The winches at the base of the mooring mast should embody this feature. This flexibility, coupled with a distribution of the cable stress over a large area of the ship, as suggested above





would afford reasonable confidence that "Shenandoah" could ride out any gale that might strike her during her Arctic venture.

We present a picture of the mooring ship which will be sent north ahead of the "Shenandoah," whenever she makes her trip. A mooring mast carried on a vessel would be liable to swing considerably, even if the ship were in sheltered waters; for the effect of a sea reaches a long distance up any harbor or inlet. Consequently, it will be inexpedient to moor "Shenandoah" closely against the mooring mast, except for such brief periods of time as it may be necessary to do so. The movement at the top of a mast 175 to 200 feet above the water is considerable, even in a gentle roll.

The bridge of a destroyer rolling ninety degrees or more sweeps through the air, at the top of the roll, at a speed of over twenty-five miles an hour Her bridge, however, is only about 25 feet above the sea. The top of the mooring mast will be, say, 175 feet above the water The ship's period of roll would be slower, but the greater arc swept through would go far to compensate for this If 'Shenandoah" were riding transversely to the axis of the ship she would be alternately pulled forward and thrust back at a speed which, due to her weight of some 50 tons, would set up heavy inertia stresses which she was never designed to meet. If she were riding parallel to the rolling ship, she would be so heavily strained, transversely, that her girders might be buckled and the ship wrecked

The officers in charge of the expedition favor the plan of letting the "Shenandoah" after she has been refueled ride on several hundred feet of cable The sag of the cable would act with a cushioning effect in heavy gusts of wind, and any rolling movement of the masthead would be damped out. Moreover, the 'Shenandoah," riding high, would be in less danger of contact with the water or with the ship itself

The Airplane and Archæology

AT the last meeting of The Archæological Institute of America, held at Yale University Prof R. A MacLean of Rochester University read a paper of the above title He said

'Among the many services which the airplane is rendering at the present time not the least is the aid which it is giving in archæological discovery In countries such as Mesopotamia where there are few maps to guide the archæologist, and in portions of Arabia which are difficult of access by ordinary means of travel, the airplane has already proved to be a valuable subsidiary help in making preliminary surveys, and in locating historical ruins and the possible sites of ancient cities'

By way of illustrating these points, Prof MacLean gave two examples, drawn from his own experience

"This last summer," he said "I went by airplane from Amman in Transjordania to visit some Roman ruins at 'Kasr Azraq" in the Syrian desert. Owing to the volcanic nature of the western portion of the Syrian desert this place had probably never been visited before by any archæologist in modern times. The ruins consist of an old Roman fortress of the days of Trajan Another noteworthy feature was the presence on the oasis of about twenty pools of clear cold water surrounded by a Roman wall It was interesting to observe that while this wall only portions of which remain, could hardly be distinguished by an observer on the ground, its alignment and complete circuit of the pools could be seen clearly from the air"

Prof MacLean's second illustration of the archæological utility of the airplane is drawn from his Mesopotamian experiences. Among the many lost cities of ancient times may be mentioned two which Xenophon speaks of in the *Anabasis* Until quite recently the difficulty in determining the site of these two cities was due to the fact that the course of the Tigris in ancient times was not known to us. But by recent observations and photographs taken from the air it is now pretty well established that that portion of the Tigris which lies to the east of Xenophon's Median Wall had its bed about fifteen miles to the west of the present bed of the river This can be determined with a degree of precision quite outside the understanding of one who has not seen for himself the way in which topographical features stand out when viewed from above The depression seen from the air and the line of mounds along the depression were the clues which led to what is thought to be the discovery of the sites of both Opis and Sittace."

Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG Chem. Eng.

Formaldehyde from the Elements.—Formaldehyde is one of the substnuces that can be manufactured from the elements, that is by the direct union of carbon acid gas and hydrogen It has been found that this union is possible when a small amount of steam is also mixed with these gases. The mixture is then passed over a contact substance which is maintained at a temperature of approximately 240 to 250 degrees C. The products of the reaction are then condensed to give an aqueous solution of formaldehyde The process is carried out in such manner that approximately two liters of the gaseous mixture are passed per hour through a contact space of about 750 cubic centimeters capacity As a contact substance porous materials, such as unglazed porcelain pumice stone, asbestos, coke, charcoal and artificially made carbon have been used to good advantage. The process has been patented in United States Patent No 1,400,244

New Drying Process.—A new drying process, which is known as the Kraus process, has been developed in Germany This consists in spraying the liquid into a drying chamber by means of a horizontal rotating disc This makes it possible to handle many substances which could not be processed in this way because they would clog the spray nozzle. The speed of the disc can be made so great that substances, which cannot be dried in any other manner, are successfully dried in this apparatus. The dryer has been used with success in the manufacture of powdered milk and is claimed to give an excellent product. It has also been employed in drying all kinds of colloidal solutions, extracts of drugs, active principles of glands, dyewood extracts, food solutions of all sorts, glue gelatine, etc. For further details the reader is referred to the *Zeitschrift fuer angewandte Chemie*, volume 35, pages 533-5

Cleaning Alabaster Articles.—There are various ways of cleaning alabaster articles, as, for instance, plunging them into lime water, washing them with white soap and rinsing carefully, rubbing with a pad moistened with pure benzine, etc. All these methods are good but attention may be called to the following one, which is recommended, especially when the articles are very dirty Impregnate the article with a solution of oxalic acid and warm water and then rinse well For further details see *The Oil and Color Trades Journal*, 1923, 1445 and *Moniteur de la Peinture.*

Glazier's Putty.—The following formula for making a glazier's putty is described in the *Revue des Produits Chimiques* It is said to give very good results, as it adheres well and hardens perfectly The putty is made by mixing together 80 parts by weight of china clay, four parts by weight of very fine iron filings, four parts by weight of talc powder and one part by weight of water When this mixture is required for use, it is moistened with a 10 per cent solution of acetic acid.

Adhesive for Mother of Pearl.—Mother of pearl, horn and wood can be glued together by means of the following adhesive preparation. Glue solution at a suitable concentration is mixed with a corresponding quantity of strong warm vinegar, adding a certain amount of ordinary alcohol with a little alum. The cement, which is obtained in this manner, possesses a very great cohesive power, and will keep perfectly fresh in well-stoppered glass bottles. The following procedure may also be observed. For natural woods, make a cement of glue and sawdust. For mother of pearl and horn, use a cement based on powdered zinc white and floor varnish.—*Moniteur de la Peinture.*

Utilization of Leaves of Trees.—It has already been suggested many times that the falling leaves should be utilized. They are said to be used for the manufacture of paper, but most experiments and suggestions have been directed towards making leaves useful for food for animals. The "Versuchstation fuer die Konservenindustrie" in Brunswick, has been working on this problem and Dr Serger has written briefly concerning the results of this work in *Chemiker Zeitung*. The foliage of a middlesized tree weighs about 50 kilograms. If only half of this is har-

(Continued on page 267)

Radio Notes

A Drop in Vacuum Tube Prices has recently taken place, much to the delight of radio devotees. Back in the early days of broadcasting, when a single-tube receiver was the height of ambition for most of us, the price of vacuum tubes did not make so much difference But now that we have four and five tube sets, every little drop in vacuum tube prices makes a great difference in operating costs

Single Tube Loud-Speaker Sets should be taken with a grain of salt. Of late there has been an epidemic of single-tube receivers for which the claim is made that they will operate a loud speaker In the case of the reflex single tube sets, there is a possibility of operating a loud speaker under favorable conditions especially if the sets are carefully made with nothing but the best parts Super regenerative single tube sets may also be made to operate a loud-speaker but here the feat is accomplished at the expense of clarity and quality of tone After all is said and done the easiest and most satisfactory way of obtaining loud-speaker results is to build or buy a three-tube set.

The Interference Problem recently referred to in these columns is on a fair way to solution in the near future The interfering spark transmitters of ship stations operating within the broadcasting wave length band are being transferred to a higher wave length well outside the broadcasting band Meanwhile, other phases of broad casting interference are being dealt with by experts particularly radiating receivers Manufacturers are being asked not to pro duce radiating receivers Publications are being asked not to publish diagrams and in structions on the construction of radiating receivers The public is being taught the necessity of making all receivers non radiat ing, to the end that the shrieks and whistles and growls of the air may be disposed of in the very near future

Spark Interference has been all but totally eliminated during the past month or two thanks to the active work of the Radio Club of America and the cooperation of Government officials and radio communica tion companies. A recent conference in New York City resulted in the abolishing of the 450-meter wave sometimes used in ship to shore radio work This wave fell in the middle of the present broadcasting band and caused some pretty mean interference for radio programs Of course this change helps matters a great deal—conditions had become almost intolerable in the vicinity of New York City due to spark interference. However it must be remembered that the ruling made by the conference does not apply to hundreds of foreign ships which will operate the same as before Further more many of our ships and shore stations are equipped with the old-style spark sets which will continue to interfere with broad casting reception at short distance until such apparatus has been replaced by the sharply tuned continuous wave transmitters.

Phonograph Attachments for converting the usual phonograph into a loud speaker deserve more attention than they have been receiving When it is remembered that the better type of phonograph has a sound chamber over three feet long and that its acoustical properties have been carefully worked out in the first place, it becomes obvious why a simple phonograph attachment can be made to deliver ample volume and sweet reproduction Furthermore the phonograph being part of the furnishings of the usual living room, can be made to serve in the additional capacity of loud speaker without detracting from the general appearance of the room The re ceiving set, especially if it be of the crude, home made type, can be placed in some remote corner of the house and connected up with the phonograph attachment by means of a twin-conductor cord The writer of this column has his receiving set in a small study while the phonograph arrangement is located in the living room some distance away A small parallel cord runs from the receiving set to the phonograph by way of the backs of furniture and under the rugs, quite out of sight.

A Voice that Spoke to Fifty Millions.—The most spectacular demonstration of radio broadcasting and wire telephony, took place on the evening of February 8th last. The ether and 5141 miles of telephone wires were joined together for the purpose of giving the greatest demonstration yet carried out by the joint use of telephony and broadcasting. It is estimated that 50,000,060 radio

listeners heard General John J Carty speak into the microphone in the Congress Hotel, Chicago. General Carty called the roll of seven broadcasting stations and twenty central telephone offices located at different cities across the United States. Telephone wires connected to the microphone led to radio broadcasting stations WEAF, New York, WJAR, Providence, WCAP, Washington; WMAQ, Chicago, KLX, Oakland KTO, San Francisco, and PWX, Havana, Cuba, all operating on different wave lengths This required more than 5000 miles of telephone lines, and 22,000 miles of emergency telephone lines were held in readiness to be switched into the big circuit between 10 30 and 11 15 o clock in the case of a break in the wires. Fifty repeating stations were used in the network of wires. The test required the services of 242 telephone employes between the broadcasting stations One hundred miles of cable was used under the Straits of Florida between Key West and Havana

Trick Antennæ are very much in evidence these days, when the crowded city apartment house must accommodate a dozen *antennæ or aerials on its roof* A number of ingenious inventors have seen fit to bring out trick antennæ which can be readily installed indoors or just outside the window taking up little space as compared with the usual single-wire antenna One of the best known of these trick antennæ is a coil of spring wire provided with two insulators which can be stretched across the usual room. Because of the coil arrangement, this antenna is supposed to include a considerable length of wire in a short span An improvement, so it is claimed, on this type is a double coil arrangement, with one coil inside another One of the recent ideas in the line of trick antennæ is a small wooden framework with several coils stretched across, which is placed on the outside of the usual window While all of these trick antennæ —for that matter anything in the way of an ungrounded wire—will give results with the super-sensitive receiving sets now available the fact remains that nothing can take the place of the standard single wire outside antenna. The short, indoor or outdoor trick antenna serves to sharpen the tuning considerably, but it also reduces the volume of signals.

What's in a Name!—Nothing is more confusing to the layman in radio than the multiplicity of circuits which confront him With a market already saturated with circuits, there is a weekly crop of new ones to add further confusion to the art and to foment greater dissatisfaction against existing circuits, justifiably or otherwise Yet the truth of the matter is that even at this late date there are very few circuits which are truly basic. Take the old regenerative circuit for example week after week some ingenious experimenter or some enterprising radio merchandiser works out a new variation of that old idea and gives it some high sounding name From that time on we hear of the wonderful XYZ circuit which is smashing DX records. And all the while it is essentially the old single-circuit regenerative circuit which has been with us for the past three or more years It is about time that the public should come to consider the essentials of radio, and to appraise all the so-called new circuits according to these essentials. Then, and only then, would the public realise that many of the new fangled sets which cause such constant upheaval, are little more than our old friends, the regenerative circuit, the tuned radio-frequency amplifier, the super regenerative circuit, the ultra audion circuit, the neutrodyne, and the super-heterodyne in disguise.

The Radio Music Fund is a bold innovation in our radio broadcasting world. After having enjoyed free entertainment for the past few years, we are now confronted with the plea to contribute something toward a broadcasting fund, to the end that we may have the very finest talent available The Radio Music Fund Committee is headed by Clarence H. Mackay, Felix M Warburg, Frederic A. Juilliard, and A D Wilt, Jr, and has for its primary object the raising of a fund for the purpose of broadcasting concerts by the world's greatest artists. The members of the committee believe that radio offers a wide and hitherto undeveloped field for stimulating and increasing public interest in good music, and the committee hopes that through the Radio Music Fund it will be possible to afford thousands of people the opportunity of hearing the world's best musical talent. The committee has selected station WEAF to broadcast the proposed concerts. Arthur Judson, concert manager, will

handle the engagement of artists for these concerts. The committee has designated the Central Union Trust Company, 80 Broadway, New York City, as depository of the fund All contributions should be made payable to the Radio Music Fund, and should be accompanied by the name and address of the contributor So far, according to reports, the response to the appeals of the committee has been most promising Just what effect this innovation will have on broadcasting activities, no one can predict at present. It will no doubt hasten that evil day when broadcast entertainers will insist on payment for their services. And when that day arrives, it will become necessary for all broadcasters to revise their plan of operation

"Monitoring" in Broadcasting.—One of the very necessary tasks connected with broadcasting is that of "monitoring" In every first-class broadcasting station there will be found some young man intently watching the fluctuating needle of a meter, and constantly manipulating a control knob. This "monitoring" has to do with overcoming the wide variation in volume which must be handled in the case of certain musical instruments For speech, the variation in average power is of the order of 1000 to 1 In music, and especially that such as given by a symphony orchestra, the energy variation between the softest and the loudest passages may be as great as 100,000 to 1 In the present state of the electrical art it is not practicable to handle such an enormous range of volume in broadcasting This limitation arises not so much from the capacity of the broadcasting apparatus as from the existence of extraneous noise The softest musical passages when broadcast must be made sufficiently loud to over ride static and other electrical interference in the ether as well as receiving set noise and any incidental noise. When the softest passages are made loud enough to overcome such extraneous interference, it would be extremely expensive to provide the equipment for making the loudest passages 100 000 times as loud Consequently good broadcasting requires a skilled listener and monitoring device at the point where the program is picked up The function of this listener is to adjust the amplifier in the broadcasting system so that its output will take into account the changes in the loudness of the program These changes in loudness must not be unduly reduced but they must be made such as will carry best to the radio audience without overloading any element in the broadcasting system

What is the Super Heterodyne? — Called the Rolls Royce of radio the super heterodyne of late has been coming into its own It still inspires a certain amount of awe among the radio laity, although, truth to tell its complex nature has been greatly exaggerated First of all the super heterodyne consists mainly of two members namely a frequency changer and a long wave receiving set It is based on the idea that a radio frequency amplifier will operate easily on long wave lengths but not so on short wave lengths. It was Major E. H Armstrong the well known radio inventor who first decided to receive the short waves and then change them to long waves in order to obtain the high efficiency of long wave radio frequency amplification Now the wave changer can be arranged as a distinct and separate unit from the usual receiving set. This device consists of a detector tube which receives two frequencies—the frequency of the incoming signal picked up by the antenna, and a frequency furnished by a vacuum tube oscillator called the "heterodyne," which feeds the detector by means of a suitable coupling. The output of the frequency changer has a frequency equal to the difference between the signal frequency and the frequency of the heterodyne oscillator This difference can be varied by adjusting the heterodyne frequency The difference in the two frequencies is impressed upon the intermediate radio-frequency amplifier The super-heterodyne can be controlled by two adjustments, one for the wave length and the other to control the frequency of the oscillator tube. One is called the wave length control, and the other the frequency changer To operate a super-heterodyne receiver the signal is tuned in as with the usual set. The incoming signal is then mixed with a signal or wave from the oscillator tube The result is a signal of much lower frequency or, put it another way, much higher wave length. This low-frequency signal is then passed to an intermediate high wave-length radio frequency amplifier, and then on to the detector

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vested each tree will furnish 25 kilograms of green leaves. Green foliage gives an average of 38 per cent of dry substance. Then out of this leaf hay which is first dried by the air and then artificially, a product is obtained which is similar to bran and can be used for food for animals. With a crop of leaves of 25 kilograms from one tree about seven kilograms of bran are obtained.—*Industrial and Engineering Chemistry*, January, 1924.

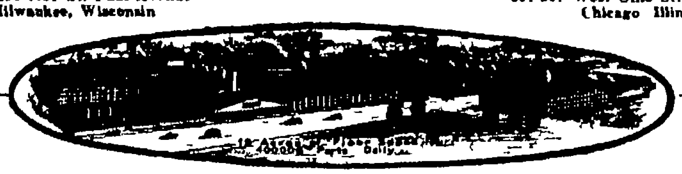
Use of Liquefied Sulfuric Acid in Industry.—As is well known, the purification of Roumanian petroleum has offered great difficulties, as it was not possible to obtain from it, as from Pennsylvania or the Caucasian crude oil, a satisfactory lighting oil through treatment with sulfuric acid. About twenty years ago the first successful attempt was made to purify Roumanian oil through treatment with liquid sulfuric acid. A special apparatus was designed which was found to be suitable for use in refineries of different sorts. Recent investigations show that liquid sulfuric acid can be used with advantage elsewhere in the industry. In the middle German lignite tar industry, hard and soft paraffines have been separated from the lignite oils by the aid of sulfuric acid producing cold, stable oils. Greases can be separated in this manner from the materials which harden them and make them viscous. Petroleum products rich in sulfur are desulfurized in this manner, as also is anthracene refined.

Use of Glue in Coating Paper.—The Bureau of Standards is carrying out some experiments dealing with the use of glue in coating paper. Nine runs have been made on the experimental coating machine using two makes of bone glue for either of the runs and a French casein glue for one. A good grade of English coating clay (Lee Moor) was used for all runs and the results indicate that the water resistance of glue bound coating containing chrome alum compares favorably with that of casein-coated papers containing no formaldehyde. It is believed that the degree of water proofing will prove sufficient for most of the papers used in half tone printing. Difficulties have been experienced in obtaining a uniform coating because of the variation in the fluidity of the coating mixture and mechanical defects in the machine so that additional work will be necessary before paper suitable for printing tests can be produced. See *Chemical and Metallurgical Engineering*, October 22 1923.

Fuel Oil from Crank Cases.—The recovery of waste lubricating oil from the crank case of automobiles for use as a fuel oil has been the subject of recent experiments by a number of commercial garage owners in Boston. Steps for the regular collection and economical salvaging of crank case oil for fuel purposes are being considered. Objection that the waste oil was dangerous because of its dilution with gasoline has been answered by the statement that practically all of the gasoline has been evaporated from the waste oil.—*Oil Paint and Drug Reporter*.

Sterilization of Perserved Foods.—At a recent meeting of the Society of Chemical Industry in Newcastle, England, a very interesting paper was presented on the subject of the sterilization of preserved foods. The most important consideration in this respect is the penetration of the heat in the sterilization process. The use of preserved foods is increasing the world over and many chemicals are being used in the preservation process. It was brought out that though such chemicals, such as borax were harmless in themselves, nevertheless, the use of them was to be deprecated because the accumulation of small doses in the course of the day was distinctly injurious to invalids and to children. The use of copper sulfate for greening peas was said to be absolutely reprehensible because it was a distinctly dangerous process, this salt possessing poisonous properties.—*Chemical Age of London*.

Red Stains On Brass.—Birmingham University in England has been giving particular attention to the question of red stains on brass and much investigation has been done in the attempt to discover the reason for this. Various possible causes such as the effect of segregation, the action of saline and acid deposits from the pickling solution and impure wash water, the influence of various qualities of rolling oils, the effect of iron and the effect of furnace gases were investigated. It is reported that the investigator said that the most important cause of stain



ing lay in the use of old-fashioned furnaces in which the flames had direct contact with the metal Red staining was seldom present before the pickling operation It was formed as a result of reactions between the copper oxides in the scale and the pickling acid. Cupric oxide was as harmful as cuprous oxide The mechanism of red staining consists in the formation during the annealing operation of oxides of copper The actual stain was formed later in the pickling operation

Wood Paving Blocks Give Up Their Junk.—It is remarkable to see what an accumulation of junk can be found in old paving blocks The metal trophies which become embedded in them include washers, screws, hairpins, nails bolts and even coins. The traffic drives them in so that they cannot be dislodged by the street cleaners, and they stay there until the pavement comes up and goes to the junkman

New Cigar Box Wood.—Spanish cedar may be supplanted as raw material for cigar boxes by a Philippine wood known as kalantas, if residents of the islands who are interested in the development of the lumber business there have their way According to a report of the Philippine Forestry Service that has been received by the Department of Commerce, kalantas is practically identical with Spanish cedar from tropical America and has the further advantage of being grown in a possession of the United States Spanish cedar has heretofore been considered the finest wood obtained in the world for cigar boxes, but kalantas is said to be so nearly like it in color, texture and odor that only an expert woodsman can tell them apart.

"Artificial" Lumber Made.—Although none of the new artificial lumber has been marketed as yet, officials of the National Lumber Manufacturers Association consider that tests already made of a synthetic composition produced by Minnesota lumber interests show it possesses many qualities making it available for structural purposes. In the process not only the trunks and branches of young trees but the leaves and smaller parts as well are ground up and mixed with other substances, virtually eliminating waste The resulting compound is capable of being molded into sizes and shapes of almost any description needed in building construction From the time the standing tree is turned by the sawmill into planks and boards and applied in construction from 60 to 65 per cent has been wasted This includes stumps, chips, bark and branches,, plank and log trimmings and a huge amount of sawdust The new method will use all of this by product.

Cinnamon—The finest cinnamon bark is produced in Ceylon where the Portuguese found the tree growing wild when they arrived in the island in 1505, says the *Bulletin* of the Imperial Institute Since that date Ceylon has been famed for this spice but owing to the small financial return it gives to the growers much of the area under cinnamon in the island has been replaced by the more profitable coconut and rubber Ceylon cinnamon moreover, has had to compete, particularly in the Continental markets, with a cheaper product of coarser flavor from the Far East Cinnamon bark reaches us in two forms the ordinary "quills," used as spice and "chips," which are distilled for the production of cinnamon oil used in medicine. The leaves of the cinnamon tree yield an entirely different oil from that of the bark this oil contains eugenol (the characteristic constituent of oil of cloves) which is employed in the manufacture of vanillin the well known flavoring agent. Cinnamon leaf oil is produced largely in the Seychelles, in addition to the Ceylon crop

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for the subsequent designation of such other Committees as shall be found necessary; they set regular quarterly meetings for the Conference, and they specify that business shall be done by the presentation to the Secretary of resolutions prior to the date of meeting At later meetings the States of Maine New Hampshire and Vermont were admitted, so that the present membership includes all the New England and Middle Atlantic States except Delaware, which has never displayed any interest

The conference is simply a voluntary association of the motor vehicle administrators of the several States, to discuss common problems with the view of working toward common decisions and common policies. It has a definitely formulated policy that it take no action save unanimously This is in no way a constitutional provision, but simply a working rule. It has never been violated, and the conference would of course go a long way before violating it. For most of the resolutions that come before the conference look more or less definitely toward new or altered legislation by the member States, and it is part of the game that the conferees go back home and urge upon their legislatures the measures that the conference has adopted. No commissioner could well go before his legislature and tell the law makers that he was asking for a certain measure against his personal judgment, but on that of the commissioners of other States' The policy of unanimous action or none at all is practically forced upon the conference and obviously any attempt to depart from it would start a lovely scrap. Incidentally, it has not yet been found to restrict the activity of the conference, to any notable extent.

The conference works mainly through committees The ordinary procedure, when a resolution first comes up, involves reference to a committee—sometimes an existing one sometimes one specially designated for the occasion There may or may not be *free* discussion at this time, as the conference elects. There certainly will be such discussion when the committee reports The resolution may be referred back to the committee at later meetings, without limit, thus keeping it alive during the attempt to overcome minority opposition Ultimately the committee will be discharged by the unanimous adoption of the resolution, in original or amended form, or by failure to adopt or to recommit Once it is adopted the several commissioners take it home with them as part of their programs for future legislation and do what they can to get through their legislatures any action which it may involve In addition the conference has certain standing committees such as one on headlighting and one that holds public hearings in search of grievances and suggestions, which originate business in committee, bringing it before the conference as it becomes in order to do so

The conference has already to its credit one very large achievement. When it was organized each State had its own headlight law, specifying the test which must be met by the front lamps on every automobile operated in the State There was no uniformity at all, devices might be legal in one of the member States and illegal in others for the tests in the various States were if not in every case different, at least different in most cases With the cooperation of the S A E. and the Illuminating Engineers Society, the conference worked out what it regarded as a satisfactory test Under the supervision of the conference and the societies named, this test has been applied to a large number of anti-glare lenses—the intent being to apply it to all that are actively marketed in the east A list has been drawn up of some thirty-odd lenses that passed this test this list specifies the candle-power of the lamp to be used with each lens, the focal adjustment, and the tilt A law making legal the use of the lenses on this list, when properly adjusted, and incorporating into the code of the State the test used in drawing up the list, has been presented to the legislatures of all the member States. So obvious is the technical authority behind the measure, so obvious its benefits, that it has been adopted in every State As a result, one can today drive anywhere north of the Potomac with the assurance that one's headlight is legal Save that not all the States have yet specifically barred other lenses than those listed, so that certain lenses are still legal in individual States which are not legal in the others, there is in this territory absolute uniformity of headlight practice.

Even so, the conference does not regard the headlight issue as settled. Through the recommendations of the Headlight Committee, the conference adds from time to time to the list of acceptable devices. Also the conference has recommended that the S A E. fix upon a standard form of focussing device, and that automobile manufacturers adopt such as standard equipment. And search is continuous for a more effective test than the one now in use.

Numerous resolutions have passed through the mill of the conference, but have yet to reach such general adoption by the member States as the headlight measures. One of these is that an operator's license law be made a part of the code in every State.

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Largely as a result of this, the New York legislature has under consideration and will probably pass a measure providing for such licensing, and removing the motor vehicle administration of the State from the jurisdiction of the Tax Commission and setting it up as an independent department in order to take care of the additional work involved.

In connection with universal licensing of operators, the conference is also on record in favor of the granting, to the licensing body or to other competent judicial or administrative authority of the power to suspend or revoke both operators' licenses and vehicle registrations. In States having no operator's license this power automatically fails to exist and not all the license States use it, while those that use it do not always define it clearly There is, of course, every argument for and no possible argument against the use of suspension and revocation as a disciplinary measure.

The conference has adopted the right-hand right-of way rule—that at intersections, in the absence of a traffic officer, the vehicle approaching from the right have the right of way The experience of Connecticut indicates that the clause that makes this a part of the State code ought also to specify that no vehicle emerging from or entering a private drive ever has the right of way over a vehicle traveling on the public road Most, if not all of the eastern States have added this rule to their traffic laws

Another resolution favors the strict enforcement of the law relative to the offense of operating a vehicle while under the influence of liquor It is interesting to record a divergence of opinion here, which prevents any action by the conference more specific than this recommendation that the existing law of each State be enforced to the hilt. At least one of the commissioners is outspoken in favor of a change in the law which shall rob the trial judge of his power to choose between fine and imprisonment as a punishment for the drunken driver, leaving no other alternative than to send him to jail. Other members of the conference feel that in the presence of such a statute many conscientious judges would create another alternative by acquitting people who were pretty plainly guilty but against whom the evidence left some loophole for doubt. This of course would defeat the purpose of the proposed measure, resulting in actual decrease of severity in dealing with intoxicated drivers All members of the conference feel that this offense ought to be dealt with unmercifully they are divided merely in seeking the best way to bring about the desired end

Another divergence of opinion is covered by a resolution in favor of a law requiring "extraordinary supervision" over the driving licenses of all persons with physical infirmities No attempt could be made to define these infirmities, for at least two reasons. Some of the commissioners regard deafness as a very large disqualification for driving while others think that a prudent deaf man is about as safe a person as can be put at the wheel of an automobile There is probably no general answer to this controversy other than that it depends entirely upon the deaf man it has been waged to a draw in several British automobile journals, and is constantly cropping up in individual cases and in the general one. Certainly, however it is fair to exercise "extraordinary supervision" over the deaf man who applies for a driver's license and to demand from him proof of his qualifications much more rigorous than that exacted of a person with normal hearing and the resolution as adopted covers this ground Again, there must be an age at which one's ability to drive safely is no longer demonstrated by one's possession of a last year's license, but may properly be questioned on each renewal Here again however the precise year at which one enters the suspected class could never be determined for the general case—it would depend entirely upon whether the parties to the argument were themselves 60, or 70, or 80, or 90, or a full hundred Epilepsy and drug addiction, the Connecticut statutes remind us are among the disqualifications which the casual critic might not think of, or the casual observer see. So on all these grounds, the commissioners agree that any infirmity constituting a potential contributing cause to poor driving ought to get special attention from the licensing body; and that more specific than this, they cannot be.

At one time and for a short time Ohio was a member of the conference. Then a Mid-Western conference was started, and Ohio withdrew to join it. The Eastern conference, as the one we are discussing is now called to identify it, has a standing committee whose chief aim in life is to promote the formation of other sectional conferences, and to cooperate with them after they are formed. It is hoped that ultimately the entire 48 States will be thus covered by five or six sectional conferences. Sectional uniformity will then proceed, as now, through action within these bodies; and nation-wide uniformity will be approached by dealings between the conferences. This should be much simpler than dealing separately with the individual States. Progress is being made in the extension of the conference idea.

We have commented, in a previous article upon the discrepancy existing among the States in the lower age limit for operators. Incidentally, we were unlucky here. We required, as a horrible example, a State that had no age limit at all, and that adjoined a State having an age limit. We picked Nebraska and Kansas and the former turned out to be the one State whose age limit we overlooked in digesting the 48 little booklets. It was there, quite plainly, and with prominent mention of the fact in the sectional title, but we missed it. Our only alibi is that if the book had had an index, we couldn't have missed it.

In the face of the divergent age limits now in use (14, 15, 16, 17 and 18 years, as well as none at all), it might be supposed that the representatives of ten States would be unable to agree upon a figure. Contrary to this expectation the conference has passed a resolution favoring a minimum age limit of 18 for all States. Only one of the conference States has so high a limit—the commissioners do not let existing laws stand in the way of their adoption of what they regard as a wise measure.

A sensible idea is the resolution favoring a law in each State that shall make it possible for the commissioner to enter into detailed reciprocity agreements with other States. New York and New Jersey have already done this on the matter of their divergent age limits, but the agreement would be of doubtful value, without such authorization if it were attacked in court. In general, the measure looks toward mutual toleration of the points of divergence which remain between the codes of the member States and is therefore not so superfluous as it might seem

The conference has gone on record as favoring the compulsory carrying of the operator's license on the person, and of the car registration certificate on the car One would be permitted to question the wisdom of the last provision, as smoothing the way for theft.

All the member States require two license plates, front and rear, the resolution favoring this practice is therefore of significance only in connection with the possible extension of the conference idea to Florida, and to one or two other States who cars we occasionally see on Broadway with a chunk of cardboard doing emergency duty as a front marker

A valuable resolution is one favoring a universal system of hand signals, and naming a committee to consider suggestions and report. There will be a wealth of these, and agreement upon one of them will be about as difficult a matter as the conference has tackled A British authority of apparent standing has recently laid down a system involving no less than five different signals. We think it will be conceded that this is too many, but whether there will be general agreement with our own view (shared by at least one of the commissioners) that one signal is sufficient, we do not know

Of great interest to the commercial owner and driver are the specific figures which the conference has adopted for maximum overall length 85 feet; height, 12½ feet; width, 8 feet, and weight, 18 tons gross. That figure "85," by the way, is not a misprint, it is made so large in order to include truck plus trailer, projecting loads of poles or structural steel, etc.

And there we are. If we are to talk about uniformity of automobile and traffic laws, and strive toward such uniformity, it doesn't seem possible to find an agency through which the talking and striving may be more effectively done than through the conference of Motor Vehicle Administrators. The items which we have set down as having come under the consideration of the Eastern conference are but a small fraction of those which would have to be taken up and acted upon in the approach toward substantial, nation-wide uniformity. But the Eastern conference has shown the way; and it is to

be hoped that it will be imitated in other sections of the country

Not alone in the actual record of the resolutions passed and incorporated into the laws of the several States does the progress made by the conference consist. The regular getting together of the commissioners and their exchange of viewpoints and experience counts heavily on the credit side. It paves the way toward ultimate agreement on points where agreement could not now be attained and it leads toward improved procedure and uniform procedure in many items outside the actual purview of legislation. Thus, at their January meeting in New York, the members of the conference discussed various schemes for restricting the number of characters on the license plate to five for the smaller States and six for the larger ones—the greatest restriction that seems in the nature of the case possible. They discussed also the matter of colors for these tags, a very large problem when there is considered the necessity for a contrasting combination different from that in use by the same State last year as well as from those used by all adjoining States this year. They discussed and are now exchanging views and data on the points of what should be and what is covered by the motor laws of the several States and how this content might be abstracted for publication in a form more intelligible than publication of the complete text gives. The office procedure used by those who have made the greatest progress in squeezing all the juice out of the registration records is always available for the guidance of those who have not utilized this resource to the uttermost. If one commissioner has unusual success in working out a novel and effective way of dealing with first offenders against the traffic law the others automatically learn of it. And so on throughout the list of the things in which these commissioners have a common *ex officio* interest.

Our Psychic Investigation

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cream of the mediumistic profession

In attempting to draw conclusions from this fact we are led in two directions. Any negative generalization which might be drawn from the failure of these second raters to get anywhere, obviously lacks direct applicability to mediums in whose behalf a larger presumption of genuineness originally existed. On the mere face of the thing no reasonable person would claim that our experiences have lent increased probability to the hypothesis that famous mediums like Kluski and the Schneiders and Miss Besinnet are frauds.

But this admission carries with it a large reservation. Our offer has not been restricted to the second raters. It has been open to all mediums. Nor have we as some disagreeable critics have claimed purposely dug up second raters to work with; we have been at very particular pains to insure that the investigation came to the attention of the first raters. Their mere silence would be significant, but their inactivity is of a more positive type than mere silence. Direct or indirect overtures have been made to several of them, and these have been ignored entirely or given a cold shoulder.

In all fairness, we must confess that there is something to be said on their side, but, we believe, nothing in any way conclusive. For instance, many sincere believers feel that the offer of a money prize is so objectionable as practically to outlaw us. But we have pointed out that this is necessary to convince the public that our investigation is to be taken seriously. We have pointed out that the medium will sometimes be put to expense or actual loss by working with us, and deserves remuneration for this. We have in several instances stated that we would be willing to pay the entire prize, or the amount by which the prize exceeds the medium's expenses, to charity or to any designated beneficiary whatever or whomever just so we pay it. This ought to dispose of the idea that the linking of these manifestations with money poisons our whole inquiry.

Then there is the matter of conditions and procedure. There seems to be a loose notion prevalent among the spiritists that these phenomena are not capable of being considered in cold blood, or tied down to definite conditons and definite examination—that in the bright light of reason, when the attempt is made to examine them critically they fade into nothing. If this argument were advanced as tending to show that the apparently objective phenomena are in fact only subjective, we could follow it. But

when it is offered on behalf of the theory that they are objective but incapable of analysis, we fail to follow it. If these things happen, we do not and will not believe that they are in any sense miracles, contraventions or suspensions of the laws of nature If they happen, they certainly happen through the operation of laws and causes as definite as those which produce a series of explosions in the cylinders of an automobile engine when the starter and ignition switches are closed. We are bound to believe that, given a repetition of the conditions, we shall have a repetition of the phenomena, in the psychic field as in that of optics or atomic physics or electricity or engineering.

Of course the conditions are complex. Of course they involve the human mechanism, and we are quite prepared to assume that they involve the physical and mental mechanisms of all those present. Of course it is on this account extremely difficult to say that in every essential detail the conditions at today's failure were identical with those at yesterday's success. But our investigators are neither children nor dilettantes and we are excessively weary of having these truisms dinged into our ears by every occultistic Tom, Dick and Harry, writing to tell us just how to conduct and how not to conduct our work

In our judgment, the main essential—granting for argument's sake that the phenomena occur objectively—is complete confidence between the investigators and the medium Mr Hamlin Garland, the novelist, tells of an investigation engineered by him in the course of which 57 sittings (we *think* that is the number he gives, in spite of the suspicious coincidence with the pickle census) were held At the beginning, the psychic thought that absolute darkness was vital, together with certain other conditions that were inimical to investigation Mr Garland found it possible to recede from these objectionable conditions a little bit at a time, putting each recession down as an experiment until he had educated the lady to believing that she could work perfectly well in good light and with limitations in other directions which at first she would not even attempt to tolerate He draws the conclusion that the conditions which are necessary are mostly those which the psychic believes to be necessary He may be mistaken in his account of the very wonderful phenomena which he obtained in good light and under good control but he certainly is sincere about it. And if the phenomena occur certainly the way to provoke them is the way he used We need not point out that we have approached each of our mediums in the same receptive attitude and held it until we were forced to abandon it If somebody will present us with a medium as worthy of patience and confidence as was Mr Garland's medium, it will be extended

It might not be a bad idea to remark here that we consider such procedure of tying the medium up as was followed in the Pecoraro case, highly objectionable but when informed that the phenomena consist in the manipulation of objects in the cabinet while the medium is tied what can one do but tie him?

From the start we realized the extraordinary range of our work and the impossibility of laying down in any detail conditions of seance procedure which should be applicable to all the cases that might come before us We therefore refrained purposely from defining our conditions, save in the most general terms We indicated that some sort of permanent demonstrable record must be got of the psychic noises the psychic lights the psychic forms, etc We indicated that this record will presumably be an instrumental one we indicated that we shall employ ordinary scientific apparatus to observe the conditions of the room and the activities of the medium and we gave a rough idea of the sort of apparatus to be thus employed We pointed out that we must be able to give an account of the proceedings which shall carry the conviction that there has been neither fraud nor error And that is all We have indicated a complete willingness to discuss all proposed conditions and all proposed tests with the medium In order that abandonment of procedures to which he might object would not necessarily imply the abandonment of the investigation, we have pledged ourselves to make every possible effort to find alternative tests and alternative conditions that will serve the same end as those found objectionable.

If a given medium were to come to us, outline his phenomena, and ask us to determine how we should test him, our response would give him grounds on which to base an opinion whether it would be worth while to attempt the production of his manifestations for us. But on the basis of what we have printed about our proposed conditions, no medium could possibly have ground for such judgment. Yet numerous mediums of rank have refused to have anything to do with us, on the explicit plea that psychic phenomena cannot be produced under our conditions. This can mean only that these mediums are unwilling to perform save under conditions dictated *in toto* by themselves. We draw no further conclusions, but the skeptic's conclusion is obvious.

One nationally known psychic, about to be presented gradually to a group of investigators in close touch with our committee under circumstances particularly favorable for building up confidence, refused to sit save in his own home, and even there refused to erect his cabinet elsewhere than in a corner where there is a door into an adjoining room Another charges us with having transgressed our own conditions by employing, with "Mr X," apparatus not known to the medium. The facts are that the apparatus in question had been approved by the medium, but that, in accordance with our terms, he did not know when we were going to use it When a medium who is perhaps America's foremost takes the stand that at every moment the operator should know exactly what apparatus and tests are in use, one can hardly avoid wondering whether she is not interested in the persistence of mediumistic fraud.

One of the psychics who has said in so many words that his phenomena could not be produced under our conditions was driven by another investigator, into a tight corner The easiest way out was to plead that he had never made any claim which would deny that he himself does the tricks, subconsciously while in trance So he promptly made this plea This medium, too, is one of the strongest bulwarks of the believers.

Something like a year ago, an influential spiritualist addressed his National Association in convention assembled. We have not his precise words, but what he said was substantially this "What are you going to do about the SCIENTIFIC AMERICAN investigation? Here is the best chance you have ever had to prove to the world that these things happen If you do not take advantage of it the world must and will conclude that you stayed under cover because you knew that you had nothing to show" Not alone did this fail to provoke any mediumistic response, but the Association actually took formal action advising its mediums against participation in our work This puts the rank and file of spiritualists in the same position with reference to us—whatever that position may turn out to be—as the mediums No plea can be made that any unsatisfactory outcome of our work is the result of mediumistic hesitation or mediumistic temperament alone Their failure to collaborate is official

Our investigation was not launched with the idea of embarrassing anybody We were in fact, naive enough to picture ourselves as seriously troubled by conflicting claims for precedence But when fifteen months pass without a whisper from any high grade medium, we are obliged to point out that if the conclusion of our work finds the believers in the uncomfortable position outlined above by one of their own number it will be they themselves and not us who will have put them there.

We are aware of the fact that most of the prominent physical mediums are Europeans, and that the American ones are remote from New York. To remove the one serious material obstacle, we make here in public print an offer which we have already made privately to one or two of those named. This offer applies particularly to William Hope, Evan Powell, Franek Kluski Erto, Willy or Rudi Schneider, "Stella C " Frau Silbert Mrs. Doane, Ada Besinnet, Mrs. Wriedt, and the Jonsons. Its applicability to the Schneider brothers, however, is contingent upon their presenting a satisfactory defence, in the event that a very recent newspaper story to the effect that they have been exposed in fraud is verified. On the other hand, its applicability will be extended to cover any medium other than those named, who makes it appear that he or she is worthy of inclusion in the same category It applies specifically to an American lady of very large mediumistic repute who sincerely seeks anonymity The omission of Eva C's name is solely on the ground that, from all reports, she appears a rather unsatisfactory person to work with, it is not to be taken as an expression of opinion on her mediumship.

To any medium named or qualifying, we will secure transportation to New York, in-

(*Continued on page 2[illegible]*)

OUR ELECTRIFIED CIVILIZATION

Where Westinghouse Serves

At home, at work, at play, and on your way from one to the other, you live in an electrified world made possible by the generation and transmission of *alternating current*—the great contribution of George Westinghouse to his fellow men

The organization which he founded has made the application of this power to every phase of human activity so natural and simple that few realize how it has revolutionized our civilization

WESTINGHOUSE ELECTRIC & MFG COMPANY
Offices in all Principal Cities *Representatives Everywhere*

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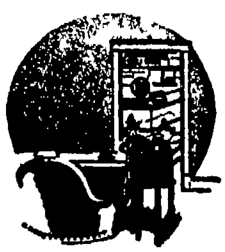
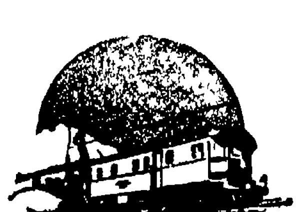
- Air Heaters
- Auto Engine Heaters
- Automatic Ranges
- Bell Ringers
- Cosy Glows
- Curling Irons
- Fans
- Fuses
- Hot Plates
- Irons
- Mazda Lamps
- Lighting Equipment
- Meters
- Micarta
- Motors for
  - Buffers
  - Grinders
  - Ice Cream Freezers
  - Ironers
- Motors for
  - Sewing Machines
  - Vacuum Cleaners
  - Washing Machines, etc
- Newel Posts
- Percolators
- Radio Equipment
- Rectigon for Charging Automobile and Radio Batteries
- Safety Switches
- Solar Glows
- Table Stoves
- Transformers
- Turnover Toasters
- Waffle Irons
- Warming Pads
- Water Heaters



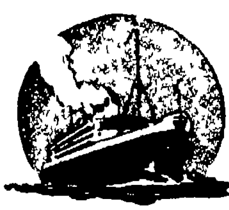
In the Office and Store

- Air Heaters
- Bread-baking Ovens
- Chocolate Warmers
- Elevators and Control
- Fans
- Fuses
- Mazda Lamps
- Meters
- Motors for
  - Adding Machines
  - Addressing Machines
- Motors for
  - Envelope Sealers
  - Tickers
  - Coffee and Meat Grinders, etc.
  - Dictaphones
  - Duplicating Devices
- Panel Boards and Switches
- Safety Switches
- Ventilating Equipment



On the Railroads

- Arc Welding Equipment
- Automatic Substations
- Baking Ovens
- Circuit Breakers
- Control Apparatus
- Electric Heating Apparatus
- Fans
- Gears and Pinions
- Generators
- Headlight Equipment
- Instruments
- Insulating Materials
- Mazda Lamps
- Lighting Equipment
- Lightning Arresters
- Line Material
- Electric Locomotives
- Motor Car Equipment
- Motors
- Motors and Control for Shops
- Pantographs
- Power House Apparatus
- Solder and Babbitt Pots
- Stokers
- Switches
- Transformers

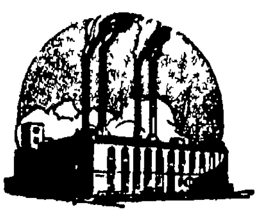


At Sea

- Condensers and Auxiliaries
- Electric Heating Apparatus
- Engine Room Auxiliaries
- Fans
- Galley Equipment
- Generators
- Insulating Material
- Mazda Lamps
- Lighting Power Plants
- Motors and Control
- Meters
- Propulsion Equipment
- Pumps
- Reduction Gears
- Switchboards
- Turbines
- Ventilation

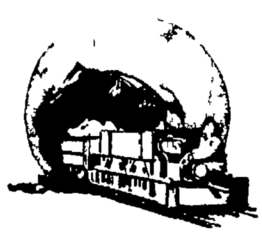
In the Air

- Channels for Wiring
- Generators for Heating
- Generators for Radio
- Ignition
- Micarta Gears
- Micarta Propellers
- Pulleys
- Starting Motors
- Stream Lining for Generators and Struts



In Light and Power Plants

- Circuit-breakers
- Condensers
- Control Apparatus
- Fans
- Frequency-changers
- Generators
- Instruments
- Insulators
- Lighting Material
- Lightning Arresters
- Meters
- Motors
- Motor-Generator Sets
- Panels and Switchboards
- Pumps
- Relays
- Synchronous Converters
- Steam Turbines
- Stokers
- Switchboards and Switching Equipment
- Transformers
- Voltage Regulators



In Mines

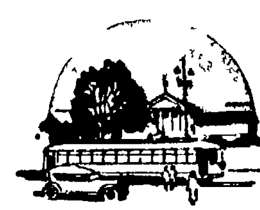
- Arc Welding Equipment
- Automatic Starters and Controllers
- Automatic Substations
- Battery Charging Equipment
- Circuit Breakers
- Electric Heating Apparatus
- Fans
- Gears and Pinions
- Headlights
- Insulating Materials
- Mazda Lamps
- Lightning Arresters
- Line Material
- Locomotives
- Motors for Hoists Pumps and Tipples or Breakers
- Motor Generators
- Portable Substations
- Switchboards
- Synchronous Converters
- Transformers
- Ventilating Outfits

In Mills and Factories

- Arc Welding Equipment
- Automatic Starters and Controllers
- Circuit breakers
- Fans
- Furnaces and Ovens
- Fuses
- Glue Cookers
- Insulating Materials
- Knife Switches
- Lighting Equipment
- Locomotives
- Mazda Lamps
- Meters
- Micarta Gears
- Motors
- Panels and Switchboards
- Power House Appertus
- Safety Switches
- Space Heaters
- Static Condensers
- Stokers
- Transformers
- Ventilating Equipment

On the Farm

- Curling Irons
- Fans
- Fuses and Fuse Boxes
- Irons
- Mazda Lamps
- Motors for all Home Appliances
- Motors for Power Purposes
- Out-door Switch Houses
- Percolators
- Power Stand
- Radio Equipment
- Switches
- Toasters
- Transformers
- Waffle Irons and the Westinghouse Light and Power Plant



On the Street

Street Railway Equipment

- Arc Welding Equipment
- Automatic Substations
- Babbitting Outfits
- Babbitt Metal
- Baking Ovens
- Circuit breakers
- Control Equipment
- Fans
- Gears and Pinions
- Insulating Materials
- Lighting Arresters
- Lighting Fixtures
- Line Material
- Machine Tool Motors
- Mazda Lamps
- Motors
- Portable Substations
- Relays
- Solder and Babbitt Pots
- Switches
- Transformers
- Trolley Poles

Street Lighting Equipment

- Cables and Conduit
- Control Apparatus
- Mazda Lamps
- Ornamental Posts
- Street Hoods
- Transformers

Automotive Equipment

- Ammeters
- Generators
- Ignition Equipment
- Lighting Equipment
- Mazda Lamps
- Starting Motors
- Switches
- Timing Gears
- Voltmeters

Westinghouse

Our Psychic Investigation

(*Continued from page 292*)

sure adequate maintenance while here, and procure return passage home at the end of the sittings—subject to reasonable advance assurance regarding length of stay and acceptance of tests and apparatus whose use involves no danger to the medium. We will give all *reasonable assurance* of good treatment. If either or both of our $2,500 awards are won as a result of this offer, we shall deduct the amount thus spent; if they are not won the financing of the investigation will be our loss. And in self-defence, we must specify that we cannot hold this offer open to late applicants, after it has been accepted by any early comer It will, however, not be withdrawn on any other ground than that it has been accepted, or that our award has been won and if circumstances justify we will extend its benefits to more than one applicant. It will expire by limitation when our original offer expires, if the original offer is extended, the continuance or discontinuance of this supplementary one will be specified

Little Fishes and Big Oil Pools

(*Continued from page 244*)

the University of Pennsylvania, Dr Joseph Leidy one of the most active of early American Scientists.

Fully forty years ago" says Dr Macfarlane Dr Leidy pointed out that the escaping oil from the Philadelphia gas works when passed into the Schuylkill River gradually became caught up between mud particles, and then the whole was precipitated as an oil clay film to the bottom where it became the foundation for oil shale or clay This was later confirmed and extended by Stuart, the Anglo Indian geologist, in his experiments with Burmese petroleum"

Going into this in more detail, Dr Macfarlane found that the mud takes up the oil two fine particles of mud and one particle of oil generally being found together But the final proof that earth oil comes from fish is found in the fact, generally known to geologists that deposits of fish bones and scales are always found in or near all known oil deposits

"I have taken the information on which my statements are based from authentic scientific records" says Dr Macfarlane at the same time that I have studied oil shales in the fields from which such supplies are directly obtained These show that through out the world wherever oil is found there is a so-called bone-bed or fish bed or fish and oil shale stratum, ranging in thickness from a few inches to several feet. Some of these consist wholly of fish bones or other remains, and each such deposit represents a tremendous slaughter of fish by some prehistoric earth cataclysm

"Oil is now being found by geologists, but for some reason no one heretofore has connected the prevalence of fish bone deposits and fish oil with the finding of petroleum or rock oil Yet it is a fact of scientific record that wherever there is oil there are these deposits stretching in some cases for hundreds to thousands of miles In some of them the explorers have found embedded perfect skeletons in such numbers as to indicate deposits of millions of fish

"The question will arise, how are these fish killed Nearly every person is familiar with the fact that a severe shock in the water kills all fish within reach, by vibration In the area of greatest intensity of an earthquake the slaughter of fish is beyond computation Coast lines are altered, also, and either by that process or by upheavals of the bed of the sea, millions of fish may be killed instantly and buried. It is then only a matter of a few weeks until the oil has been forced out of them into the surrounding shale, by pressure and decomposition, so that the shale then becomes a 'producer' rock. The oil often migrates, however, to adjacent strata which may then become reservoir rocks or sand This process goes on all the time. It is not necessarily confined to earthquakes. We do not need to list all the causes of death to fish. It is necessary only to consider the vast area of the sea the teeming multitudes of known specimens of fish, the known yields of oil to realize that the waters of the earth constitute an almost limitless distillery for the production of crude petroleum.

"There is every promise of great and sufficient oil supplies for the future, especially if present known oil strata are penetrated to increasing depths, but in continuing anticlinal relations. Increasing utilization also of oil shale rock will furnish practically ex-

haustless supplies for many countries where these are found. Its extraction at reasonable cost should be one of the problems that inventive science should solve A skilled scientific staff of geologists and paleontologists should have wide and accurate knowledge of fossil fishes and even fragments of them, so that when definite areas are investigated it may be possible to locate and follow the important oil bearing zones along with any by the aid of their typical fish fauna.

How Gold Leaf is Made

(Continued from page 244)

original one-inch square of rolled sheet A pack is then made out of a thousand sheets of leaf, interleaved as before between sheets of goldbeater's skin, and this is again beaten with an eight pound hammer Final size of the leaf is five inches square. The last beating operation lasts on the average twelve hours, dependent on the weather, and the steadiness of the eye and arm of the beater

The finished films are laid on calf skin cushions and cut with a little device, made in the form of a bob-sled from lacquered Japanese cane Strips of malacca reed are glued into the runners and serve as the cutting edges. Great care must be exercised in this operation for the extremely thin films of gold are easily torn The fineness of these leaves of gold is demonstrated by the fact that they can be torn without any difficulty at all by blowing the breath across them After being cut, the leaves are placed in books made of tissue paper and coated with ochre Twenty five leaves are found in each book.

The entire duration of the gold leaf process is 35 hours The whole thing is a matter of beating pounding a heavy hammer to spread the gold into a fine film and at the same time using great skill to avoid tearing holes in the sheet Gold leaf is used in making signs but it also has a few additional applications Handtooled books are usually lettered in gold leaf, and furniture and fine woodwork are decorated with it Its sole technical or scientific use seems to be making the electrical instrument known as the electroscope, which is used for detecting static electricity

Gold leaf is not to be confounded with gold foil The latter used by the dentist in filling teeth is very much thicker than gold leaf. A sheet of gold foil, four inches square weighs from four to twelve grains, while 25 sheets of gold leaf of the same size weigh approximately five grains.

New House Bill Aimed at Patent Frauds

IN JANUARY, Representative Lewis C Crampton, of Michigan, introduced H R. 5790, whose salutary purpose is to prevent fraudulent, deceptive, and other improper practice in connection with the prosecution of patent applications before the United States Patent Office In urging his bill which deserves every support, Representative Crampton said that, in Washington and a number of other places throughout the country individuals firms and even corporations are acting as patent attorneys and inducing clients to entrust important patent business to them with the idea that they are authorised to practice before the Patent Office and he also suggested that in several instances attorneys who have been disbarred from practice before the Patent Office are practicing under cover, while other men who have never been registered, and who are not entitled to be registered, are representing themselves as patent attorneys and taking fees as such He incidentally calls attention to a case wherein one of his own constituents was led to pay some $1500 to an association not registered, but practicing, and not having any right to practice The purpose of Representative Crampton's bill is to prevent anyone from practicing directly or indirectly before the Patent Office who is not registered to practice, or who has been disbarred

The Senses of Bees

THAT bees are color blind as people sometimes are, and that they learn their way about by perience rather than by instinct is the conclusion reached by Prof. F Frisch and Lothar Tirala, German biologists, who have made a careful study of the insects These investgators have shown that to the bee, red and black look alike, orange and yellow look the same as green and that *there is no difference* in the appearance of blue, violet and purple. But bees have one advantage over man; they can see the rays of ultraviolet light, which are invisible to our eyes.

It was also discovered that the mysterious guiding influence by which the bee is brought

back to its hive is nothing more than experience. It has long been known that bees find their way home sooner the longer they have lived in their hive. To test this common-sense view bees were put to sleep by ether, taken to a new hive, and moved some twelve yards away None of them could find their way back to the hive until the third day afterward, when 30 per cent got home. By the eighth day, however, 90 per cent of them had learned to find their way back to the hive.

Man-Made Lumber

(*Continued from page 250*)

thoroughly cemented to this blanket. This makes the blanket of increased strength, water and moisture resistance, and renders it absolutely impossible for any air currents to pass through it. The final step in the manufacture of balsam wool consists in trimming and slitting the blanket into such widths and lengths as are desired, after which the blanket is rolled up into bundles and is ready for shipment.

Thus, it will be noted that in the manufacture of balsam-wool certain steps in the paper making art have been made use of, but the individual fibers have been fabricated by an entirely new formation in order to get the low density and high heat resisting properties desired The new product is not paper it is of a truth, as our title implies, artificial lumber

Owing to the remarkable lightness with which the wood fibers have been rearranged, balsam wool has found a ready sale wherever it is desired to prevent heat losses, especially in the insulation of houses cars, etc Homes, for example, insulated with balsam wool of which a great many have already been built in the Middle West, are not only more comfortable to live in, but can be heated with a saving of over 30 per cent in the amount of fuel ordinarily required

The second product more recently developed at Cloquet is quite different from the balsam wool just described although it is made from the same raw cellulose material This product, to which the trade name nu wood has been given, is a dense solid mass of tree fibers pressed together into boards 4 feet wide by 16 feet long and varying in thickness from 1/3 to 5/8 inch These large boards are then resawed into smaller boards of any size desired Since the process starts with the individual fiber just as in the paper industry, it is possible to use the natural wood in any form or size whatever In fact, the process uses sizes and forms of wood even too small and crooked to be ordinarily profitable to the paper maker thus slabs edgings sawdust trimmings etc make an ideal raw material for the manufacture of nu wood and from them is made a finished product which can be sawed nailed sanded and finished like natural lumber, but with the added advantage that it warps less and has no defects such as knots, shakes, pitch pockets worm holes etc In the lumberman's vernacular nu wood is all "F A S" or clear on all sides

In the manufacture of nu wood the saw mill offal is first chipped to small particles and is then treated with an alkaline solution but not to the same degree as in the manufacture of balsam wool The alkaline treated chips are then ground mechanically in the presence of water, so that they are torn to pieces and the structure of the individual cells in many cases is completely destroyed In this condition they are sized to render them waterproof and are then flowed in a current of water on to a screen and subjected to heavy pressure to force out the water The pressure reduces the mass of fibers to a stiff board like cast of wood, which is then subjected to heat so that the remaining moisture is reduced to about six or eight per cent. The final result is a stiff, strong dense board of wood fibers, so intermingled and interlocked that the synthetic product has none of the grain characteristic of natural wood

Nu wood is designed to compete with lumber for such purposes as furniture cores, boxes, wood trim, panel stock, etc. It takes paint as well as natural wood and as it holds glue most tenaciously, it makes an excellent base for veneer stock

Bombing the Battleship

(*Continued from page 252*)

ship fleet is attacked by airplanes the attack comes with such suddenness, that the airplanes, which are "tied" to the ships and carriers, cannot possibly get warmed up and into the air before the attack is over and the attacking craft have flown far from the scene. The power of position! It takes time for the airplanes of the battlefleet to gain the same altitude as the attackers, and until they have gained this altitude they are useless. It would be only a rare and fortunate occasion on which the airplanes that were being carried by the battleships would be hovering fifteen thousand feet in the air waiting for a supposed attack. For scouting and observation purposes small airplanes or balloons could be used with advantage by battleships; but a fighting force of aircraft tied up with a water fleet would certainly appear to be of little defensive value against aerial attacks. A battleship might as well take along submarines to combat enemy submarines.

Above all it must be remembered that bombers can now operate at *low altitudes*. There has been very little said about this! But the bombing tests that took place off the coast of North Carolina last September opened the eyes of observers who saw it. The smoke screen and smoke bombs now make it possible for a fleet of airplanes to attack a fleet of battleships from the extremely low height of five hundred feet at point blank range.

The strategy can be worked in this way Two or three fast and small airplanes may drop from a formation that is approaching or has not yet come in sight of the battleships, and circle the targets with smoke screens, or curtains. Their speed of about 200 miles an hour would provide a humming bird sort of a target to anti aircraft gunners. The bombers following up could sweep down behind the screen, break through at an unexpected point, drop the bombs upon their targets and disappear behind the smoke screen on the other side. The anti aircraft gunners have had to sweep their pieces through an arc of about 180 degrees within a few seconds and do it amidst the bursting of shells, and probably with burning phosphorus (see illustration) running down their necks. This maneuver was not carried out last September, but it was apparent that it could easily have been done. Many expert observers were of the opinion that a formation of bombers could burst through that heavy white wall of smoke and attack at a low elevation

In such an attack the first attacking planes would be of the fast type, carrying lightweight poisonous gas or liquid flame bombs, which they would drop upon the battleships This would force the personnel into gas masks or below deck, so that manning the anti aircraft guns would be out of the question

Although anti aircraft fire can never be entirely overlooked or minimized by airmen, means are available to make it ineffective, such as armor, altitude, smoke, poison gas, and liquid fire An attack through smoke can get carried out with still greater safety, by airplanes dropping smoke bombs from a great height a half mile or more from a fleet of battleships, in such a position that the wind would blow the smoke over the ships, shutting off horizontal and vertical vision, but still enabling aircraft to spot them amid the haze It has been learned from flying that a heavy ground mist which greatly obscures vision from the ground can be easily seen through from the air when a little altitude is gained

Great bewilderment would be imposed upon a fleet of battleship commanders, if they were suddenly plunged into a smoke fog while they were steaming in formation, and tons of bombs to begin raining upon them from above—bombs of gas, fire and explosives. Random or fleeting shots from anti aircraft would be of little value. The aircraft, tied to the battleships, could not take off in the smoke with safety These smoke bombs, too, would no doubt contain poisonous gas. It is rumored that a bomb has been developed in Europe, containing a heavy gas that eats into the flesh like strong acid, and that another has been tried out that contains liquid which eats into steel as hydrofluoric acid into glass.

Another possibility of attack was apparent last September In the early morning low clouds hung over a glassy sea. It would have been easy for the fleet of attacking bombers to approach their targets just inside these clouds and, after dropping their bombs from the cloud base which would partly have hidden them from the anti-aircraft gunners on the battleships, to have swung up into these clouds, where they would have been practically immune from gun fire. With the staunchness of modern airplanes and the development of navigation instruments, foul weather, such as low-hanging clouds and winds that churn up choppy seas, forcing gunners to fire from an unsteady [illegible], become a positive ally of the aviator.

The kind of service that sells Kelly Kats

Sometimes a truck-owner's need for traction is so great that he may buy Kelly Kats for this one quality alone. Another truck-owner may buy them for the exceptional mileage they give, or the cushioning they afford; but the majority of men who use Kelly Kats do so because they combine *all* these qualities to a marked degree.

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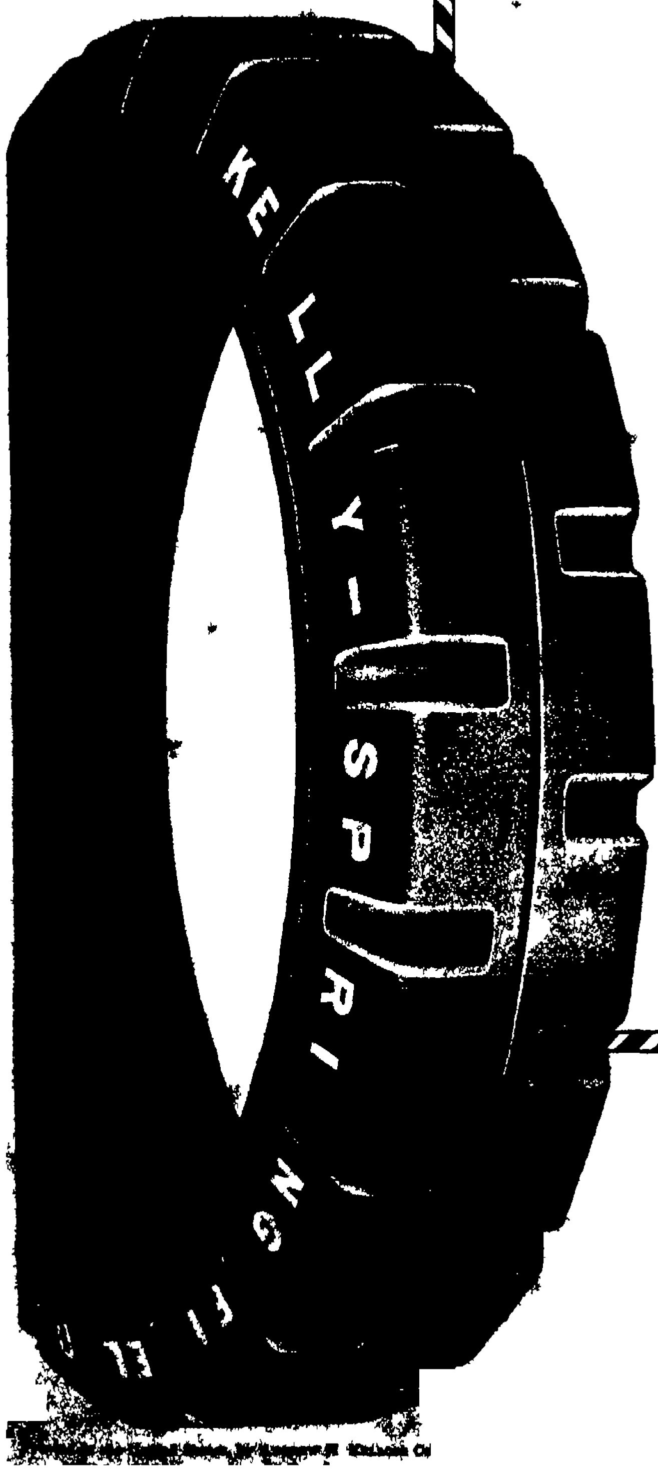
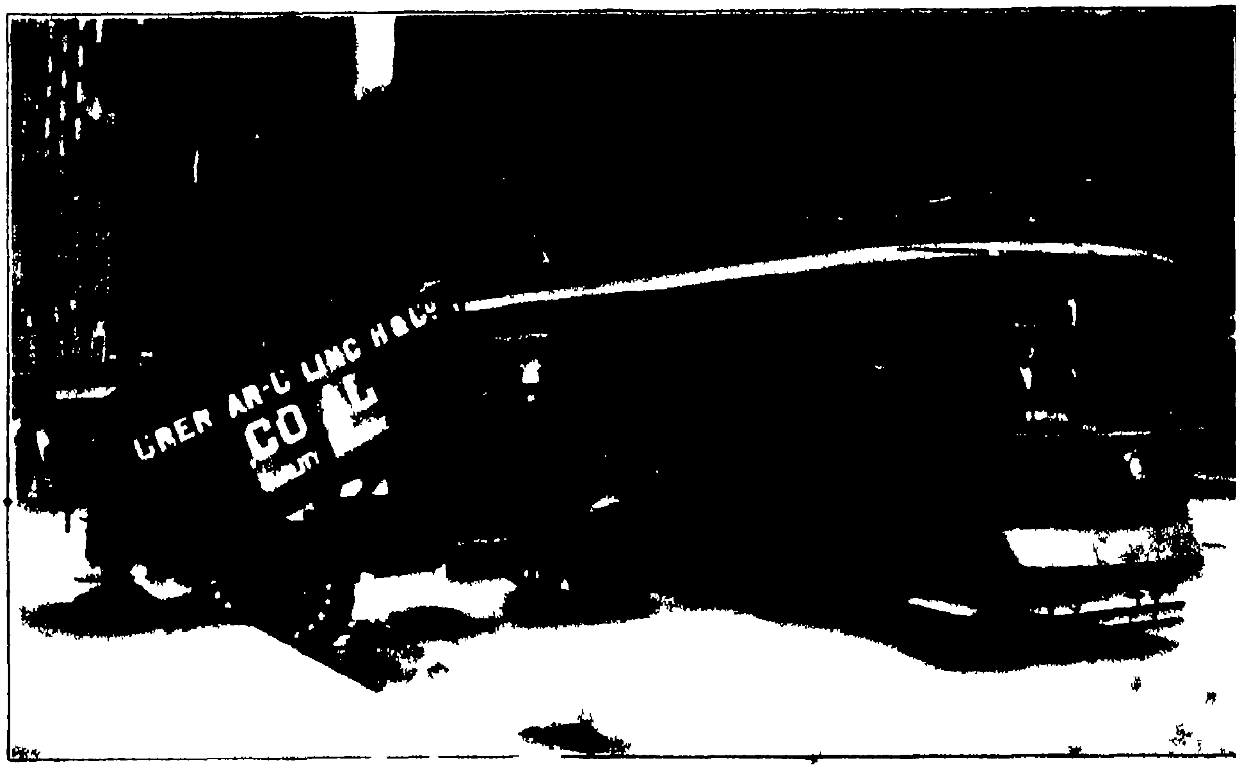


KELLY
TRADE MARK REG.
KATS
THE TIRES WITH NINE LIVES



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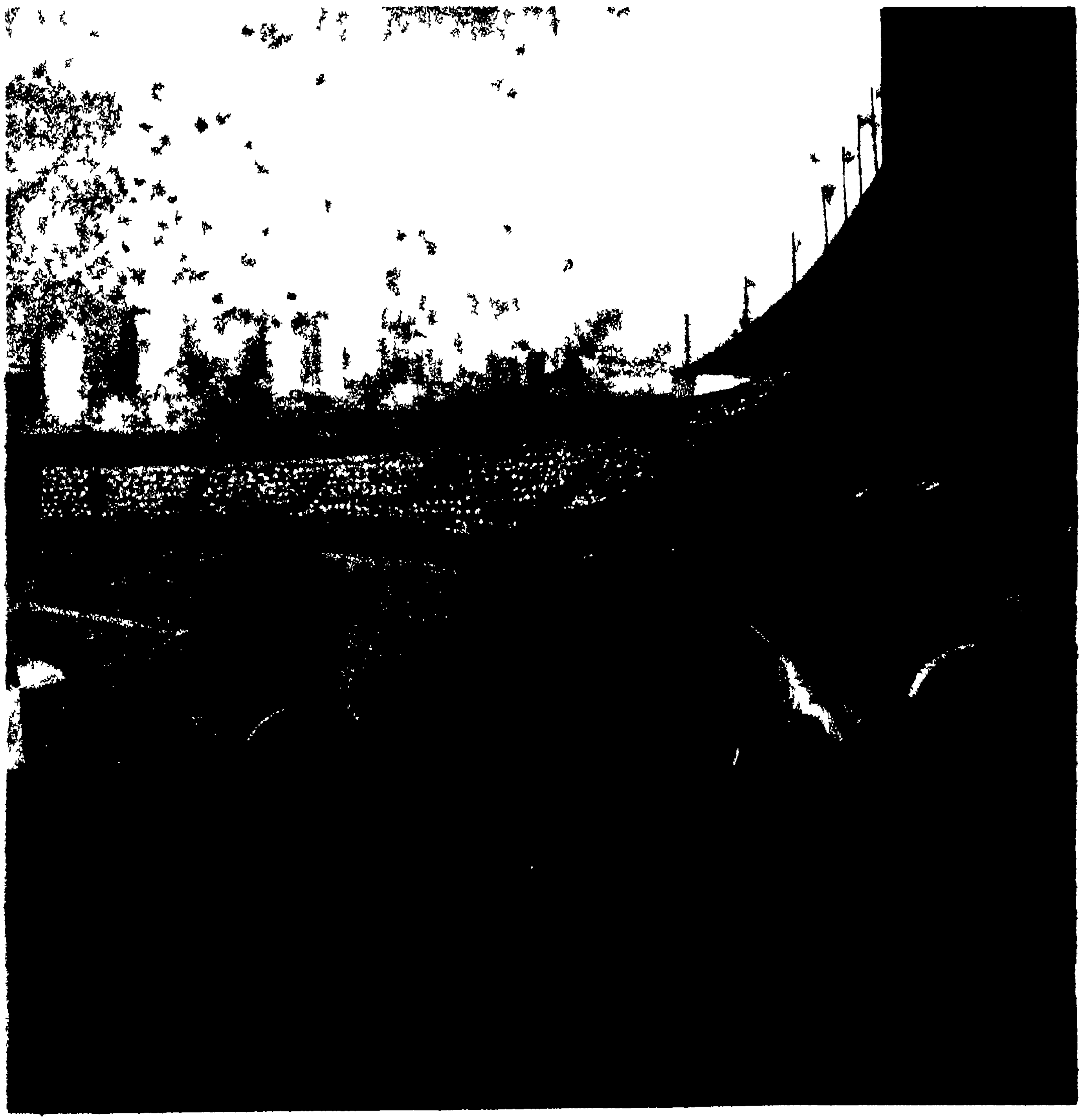

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LINCOLN MOTOR COMPANY
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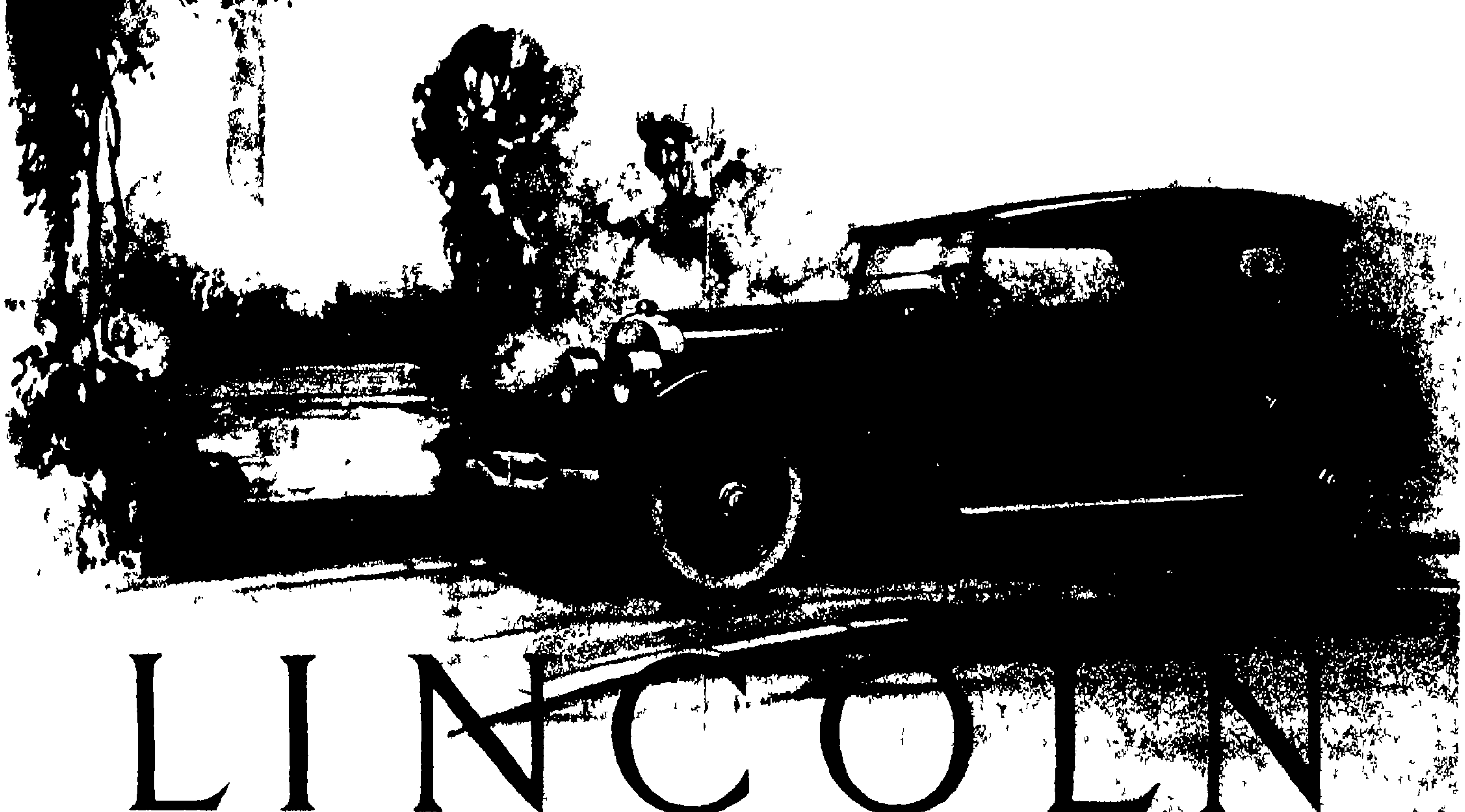

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With the Editors

SOMETIMES we employ this page to give you a taste of what is coming along in future issues, but another legitimate function which it must also serve is that of telling you something about the personalities that contribute toward making the current issue what it is. In the present case, Sir Oliver Lodge occupies the post of honor. An article from him on atomic physics is the strongest possible evidence of the SCIENTIFIC AMERICAN policy of going to the man who knows, for direct, first hand, fully authoritative statements of the latest scientific advances. Sometimes this policy cannot be put into unadulterated execution, the man who is able to go into a laboratory and come out with a contribution to human knowledge is not always able to write about his own achievements in a way that shall make the best appeal to the layman. He may be the world's leading scientist, yet lack the sense of proportion that enables the successful writer to slide over the minutiæ and spot the big outlines of the story. Or he may be, in plain English, a miserable writer—lots of perfectly intelligent workers in professional fields are just that, we know prominent doctors who can't write a decent letter. In such instances, the first hand account that appears, nominally under the signature of the great man has actually been prepared by a member of our own profession—one whose business it is to go out and get in contact with a story, absorb its essential features, and write about them sequentially and interestingly. But when we present an article by Sir Oliver Lodge, the world knows that no such intermediary has been at work, that the text is in Sir Oliver's own crisp illuminating style, quite free of any journalistic tinkering.

SIR OLIVER does not exhaust the list of first-hand authorities who address you through the pages of this number. One of the leading research institutions of the country, so far as the solving of major industrial problems is concerned, is the Forest Products Laboratory, of Madison, Wis. Anything that you want to know about wood or wood products the F P L either knows or will find out. And from time to time, when they have completed a bit of research in which the procedure employed or the results attained are such as to be of general interest, we give them the space to put before our readers the first hand statement of the man who has done the work. It may be Mr Tiemann or it may be somebody else but whoever it is when the story carries the Forest Products Laboratory label you may know it is by the man who did the work.

ANOTHER person who to the highest degree combines the power of advancing the cause of science with the ability to tell about it in proper proportion and in thoroughly interesting fashion is Dr Luckiesh. We suspect very strongly that he knows more about the practical application of light than any body else in the world. And we have a very strong personal reaction toward him as well. He, as much as any person with whom we are acquainted, contradicts the old-fashioned idea of the old fashioned scientist as the man with spectacles, long whiskers, an abstracted air and a complete detachment from the material things of the world. If he entered the room with an eminent lawyer, a successful bank president, or a prosperous hardware merchant, anybody who did not know him might be pardoned for surveying the pair and asking, "Well which one is the scientist?" Perhaps one reason for the greater popular confidence in science today than yesterday the greater willingness of the world of affairs to believe that the scientist is standing on both feet and has his head firmly attached to his shoulders, is the prevalence of scientists of the type so well represented by Dr Luckiesh.

NO less vivid in the editorial mind is the personality of Dr Gradenwitz, through whose efforts we have the important and absorbing article descriptive of Dr Bruck's work. Dr Gradenwitz more than any other of our friends represents the successful execution of a preconceived plan. Physically disqualified from the military or official career which automatically formed, before the war, the goal of every German of the educated classes, Dr Gradenwitz entered the University with the deliberate intent of making a linguist of himself. How well he succeeded is testified by the fact that he contributes to so many different publications in so many different tongues that he finds it desirable to have several typewriters scattered about his study, in order that he may avoid the removal of semi finished work in one language to make way for an emergency job in another. When we first called upon him, high up in the apartment house out in the Friedenau district, which he and the other tenants have to run themselves in lieu of the defaulting landlord we found him pounding out correspondence in German on one machine while a half finished article which he was translating into English from a French original stood at attention in a second. The Doctor translates thus, or indulges in original composition if the circumstances admit of this in and out of all the languages of western Europe—and perhaps some of those of the eastern half. And we know of nothing quite so typically German as the way in which, responding to a ring he blares into the telephone transmitter, "Grau a a a-denwitz!"

SPEAKING of German telephones—they have one little wrinkle which we opine, might be worthy of America's attention. Using the instrument at Zentral 6557, say one desires to call Dr Gradenwitz at Rheingau 1308. When the operator at the Zentral exchange answers, one does not shoot the whole number at her, American style one simply asks for the Rheingau exchange. That is one enunciates the single word Rheingau' and in a moment one hears the same word repeated in one's ear by way of notice that one has got Rheingau. One then asks for number 1308 without any prefix of course and one gets it. With fewer repetitions of the number it stands to reason there are fewer wrong connections given.

BUT one other vagary of the German phone we never did and never would get used to. Instead of giving the number by single digits as we do, they give it in blocks of two. Thus 2578 would be "twenty five, seventy-eight" Well that's all very fine until you start doing it in German when it becomes "fünf und zwanzig acht und siebzig" —in English five-and twenty eight and seventy. There is a curious interlocking turned inside-out of feet to this which must be experienced to be appreciated

CONTENTS

MAY, 1924

LEADING ARTICLES

SHORTER ARTICLES

DEPARTMENTS

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EIGHTIETH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, MAY, 1924

THE announcer's microphone (1) is located in a sound-proof announcing booth having double plate glass windows and giving clear vision to both studios. Special walls render the booth practically impervious to sounds from the studios. The loud speakers (2 and 3) in the studios repeat the announcer's introduction of artists and also enable him to give directions regarding placement of instruments and singers while the studio is idle. Switches on the announcer's control panel (4) enable him to switch in his own announcing microphone or those in large and small studio (5 6 and 7) There are two microphones in each studio, one regular and one emergency The announcer's loud speaker (8) enables him to hear the performance as heard by the radio audience so that his directions are given from the audience's point of view The signal lights (9 and 10) indicate by colored lights whether or not the studio is on the air, the carrier wave is being sent out, the microphones are switched in or studio director or announcer is wanted on the telephone Each door to the studios has a red signal light (11) which indicates that the studio is on the air If any one disregards this signal and opens the door when transmission is taking place the loud speakers are automatically disconnected As a further precaution the doors (12) are equipped with special knobs which can be opened only by some one familiar with them A loud speaker (13) concealed in a horn closet, reproduces the broadcast entertainment for the reception room A ventilation system through ducts (14) keeps the studios and reception room cool and comfortable under all conditions even though all windows are closed Adjustable deadening curtains (15) are readily adapted to suit the music being transmitted. A double wall with dead air space (16) prevents radiation of hall and elevator noises from the main corridor to the studio The announcer who is the key to the whole situation is in direct communication with the engineers through desk telephone (17) The equipment panels (18) are mounted with all the necessary apparatus for controlling the microphone amplifiers and input currents to the special cables connecting the studio with the broadcasting station as well as controlling and adjusting remote control telephone lines which operate the station from outside points. Special equipment for equalizing lines to correct attenuation, as well as instruments for measuring the gain of any amplifier and group of amplifiers is provided Behind the panels is a large loud speaker (19) which provides the monitoring engineers with either the studio output or with the output of a loop radio receiver The individual views show (1) the studio (2) aerial (3) broadcasting (4) control board

THE RADIO BROADCASTING STUDIO OF 1924: A VISIT TO STATION WEAF IN NEW YORK CITY

"This Is Station ——"

Putting Radio Programs On the Air and Taking Them Out of the Air

By Austin C Lescarboura, Mem A I E E

Author of Radio for Everybody Wireless Course etc

ONE two, three, four five Hello, Fort Wood One two three four five Hello Fort Wood Here's some music for you' And a moment later came the strains of the Anvil Chorus from the opera Il Trovatore played for about the fiftieth time that day by the hardworking cylinder type phonograph of rather questionable musical attainments

That was the radio broadcasting program of 1909 As a matter of fact it was not intended as a broadcast feature Back in those days we firmly believed that radio telephony might be used as a rapid means of wireless communication especially for military operations Of course we appreciated the fact that the radio telephone conversation could be intercepted by anyone, but it never occurred to us that this means of communication might be employed for nation wide entertainment Little did we dream that the very weakness of radio telephony—its total lack of secrecy—would some day become its greatest asset

Major E. H Armstrong, the well known inventor of present day radio receiving circuits, and his latest model of super-heterodyne receiver

With Sputtering Arc and Baked Microphone

No beautiful broadcasting studio was available in those pioneer days for our radio telephone efforts Instead we were working in the icy cold room of the wireless station located behind the big disappearing guns of Fort Hancock, amid the barren wastes of that stick of land known as Sandy Hook No neat and almost invisible microphone was presented for our vocal talent, instead, we were shouting into a long fiber horn, as we stood before a large table fitted with a tall back covered with delicate electrical meters and fuses and switches Immediately before us were ten tall copper cylinders filled with water and resembling nothing so much as the pipes of an organ Below each copper cylinder was a large carbon button, all but pressing against the bottom of its respective cylinder Between the cylinder and the carbon button played an unsteady electric arc, sputtering and flickering all the while The ten arc units were arranged in two banks of five arcs each, each bank controlled by a large upright handle, so that all five arcs of the bank might be struck at once Once the arcs were formed by touching and then separating the copper and carbon members, it was necessary to adjust the gap of the arc so as to get the utmost stability making for uniform radio waves on which to impress the telephone message or music And here was the annoying feature for no sooner did we get one of the arcs fairly constant and turned our efforts to the next unruly arc than the first arc would go off on a rampage, electrically speaking

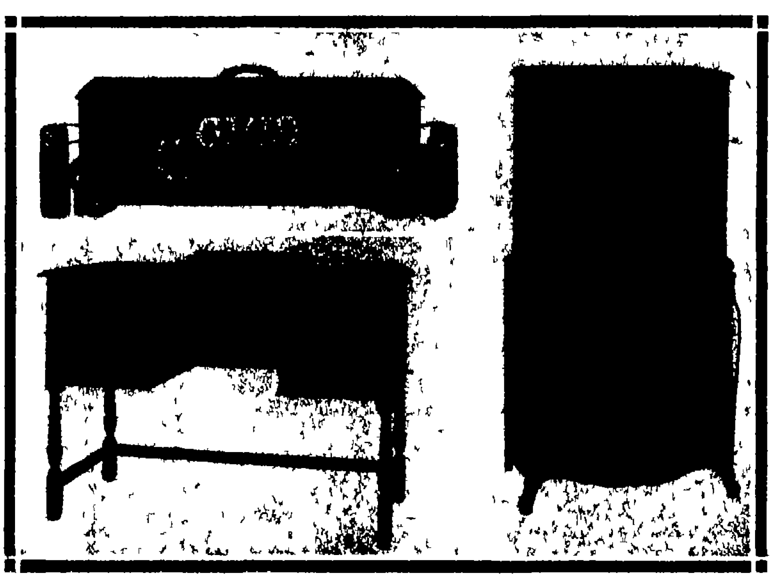
Given exceptional luck it was possible at times to get all ten arcs on their best behavior This happy state of affairs was confirmed by the passive state of one of the electrical instruments known as the oscillating circuit milliammeter

The next step was to prepare to talk The microphone, or device which translates sound waves into their electrical equivalents, was in this case a flat cartridge with two contact buttons It was slipped into a holder over which was placed the long fiber horn Then if the arcs were still behaving themselves we were ready to talk—or shout, to be more precise in our description

All of which was for the purpose of convincing the United States Army Signal Corps that here was a wireless telephone that would work—on occasion We were endeavoring to put some sounds into the air at Fort Hancock and trying to get those same sounds out of the air again at Fort Wood eighteen miles away as the crow flies The Fort Wood receiving station was by no means of fortunate location so far as radio is concerned because it nestled right at the very feet of the bronze lady known as the Statue of Liberty Despite the application of a five-kilowatt input at the transmitter—just ten times as much energy as the usual present-day broadcasting station—we could only hope to get through to our anxious listeners in once in a great while

The output from our arc transmitter was passed in large measure through the cartridge microphone with the consequence that the loose carbon grains of the microphone were soon baked into a solid mass by the developed heat All the while we were speaking or playing the phonograph, it was necessary to rap the microphone holder with a screw driver so as to break up the baked carbon grains in order that the sound waves could be accurately translated into variations of the outgoing radio waves At the end of several minutes of more or less uncertain transmission the microphone would be baked solid and a new one would be necessary

That in brief, was the 1909 model of radio broadcasting station The author, who participated in those early radio telephone attempts, had no illusions about the possibilities of radio telephony To him as well as to others engaged in that early experimental work, the technical obstacles were such as to seem insurmountable As a laboratory experiment the radio telephone was indeed interesting but as an everyday convenience, it was doomed to failure



Three 1924 models of radio receivers. Upper left Standard super-heterodyne partly open to show the six tubes, tuning condensers and batteries. Lower left Handsome period cabinet receiver Right Cabinet type regenoflex receiver, with self-contained loud speaker

And Along Came the Vacuum Tube

In the annals of a young art like wireless communication, fifteen years is an age Even as we were experimenting with our crude arc transmitter, Lee DeForest a wireless experimenter and inventor already well known at that time, was at work on his audion—a modified form of electric bulb in which are placed two elements in addition to the usual filament one of these a metallic plate or cylinder, known as the "plate," and the other a lattice-like structure known as the grid"

Four years after our disheartening efforts at wireless telephoning a young student at Columbia University Edwin H Armstrong was delving deeply into the intricacies of the audion or vacuum tube, and evolving new and wonderfully efficient circuits for radio transmission and reception That was in 1913 Two years later the American Telephone & Telegraph Company startled the world by assembling a large battery of vacuum tubes for the purpose of generating radio waves with which the human voice was projected through space from Arlington to Paris Then, as if the spanning of the Atlantic were not a sufficient accomplishment the telephone engineers immediately followed up this feat by talking between Arlington and the far away Pearl Harbor in Hawaii a distance of 7500 miles That was in 1915, the same year that the trans-continental telephone line was inaugurated—an astounding engineering achievement also due in large measure to the application of the vacuum tube, this time as a perfect 'repeater to build up attenuated voice currents at intervals on their long journey from coast to coast

From 1915 the story of the radio telephone moves along through the trying days of the World War With our entrance into the fight we found it necessary to develop the radio telephone as a means of rapid communication between airplanes and the ground It is safe to say that years of normal radio development were crowded into months in those days of great anxiety

Then came 1921 The Westinghouse organization began a series of radio telephone experiments for the purpose of testing certain microphones and radio telephone transmitters. Soon the radio amateurs took keen interest in those experiments After a while the Westinghouse organization found that its experiments were coming to be looked upon as a public institution Aside from radio amateurs, who are primarily interested in communicating with one another by means of the dot dash language of the telegraph code, numerous laymen were buying receiving apparatus so as to listen in on these experimental talks and phonographic concerts which could be taken out of the air

So radio broadcasting came about, and the rest of the story is of too recent origin to require reiteration at this time If anything it is the present-day vacuum tube which has made radio broadcasting possible The pioneer workers, making use of the troublesome and uncertain carbon arc for generating the radio waves, were hopelessly handicapped Not only was the carbon arc most inefficient in the generation of radio energy, but such energy as it did produce had to be handled more or less directly with a microphone which could not stand up under such an electrical strain Back in our 1909 experiments we had to change microphones about every five minutes—and each microphone cost us about $3 00!

Now the vacuum tube is the marvel of modern electricity It can be used to convert direct current into alternating current of very high frequencies, suitable for radio transmission Feed it alternating current of any frequency, and it will convert such current into direct current It may be used to detect delicate radio waves in fact, it is a super-sensitive detector in radio work. The vacuum

tube acts as a relay or repeating device, in that it will impress on a powerful current every characteristic of a weak current. It is this facility which permits of using the vacuum tube as an amplifier in radio receiving, or as a so-called modulator in radio transmission, when the delicate voice currents are impressed on the powerful transmitting waves or as the repeater in the long-distance telephone line, when it becomes necessary to boost up the attenuated telephone currents at the end of every so many hundred miles of line.

The Gentle Art of Broadcasting

How quickly we have become accustomed to broadcasting! Only a few years back we were contented to spend our evenings reading the newspaper, a magazine, or a bulky book. If we desired a little entertainment, we went to the nearby motion picture house or to the theatre. Or we even called on our friends in order to pass the evening.

Today it is quite different. On our way home we look through our newspaper for the radio programs. We learn what is going to be put on the air tonight for our entertainment. Not only do the radio programs tell us the names of the artists and speakers as well as their offerings, but also the exact time at which we can look for those very features. Instead of having to go out for our entertainment, we have merely to turn the dials of our radio receiver to the proper settings, and the entertainment comes to us from out of the sky. It is now too commonplace to be fully appreciated, this wonderful thing called broadcasting.

There are two sides to radio broadcasting: first, the talk or the music must be put on the air by means of a radio telephone transmitter; secondly, the talk or the music must be taken out of the air by means of a receiving set. The radio waves which carry the talk or the music are strongest when nearest to their source, and gradually grow weaker as they spread out in ever widening circles to the vast radio audience. The object of the receiving set is to intercept a small portion of the desired radio wave in its immediate vicinity, by means of "tuning" or adjusting the frequency of the set to the desired wave, and then convert the energy of that radio wave into a replica of the original sounds. The nearer we are to the broadcasting station the more powerful the waves and therefore the more radio energy can be intercepted. Furthermore, the more powerful the radio energy that is being handled by the receiving set, the simpler the apparatus required.

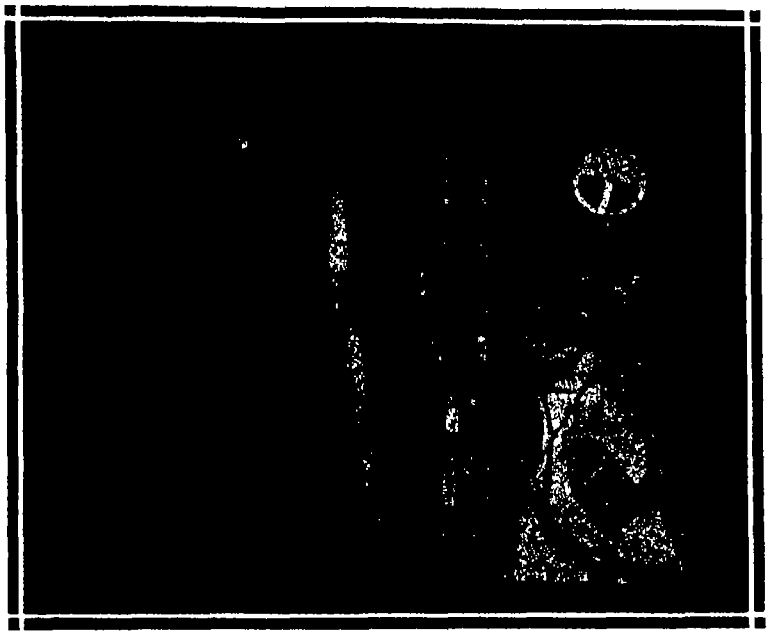
All of which may be quite elementary but is quite necessary in preparing us for an understanding of the present trend of broadcasting.

Typical multi-tube radio frequency portable set, with self-contained loud-speaker. The loop is in the lid of the case

The latest statistics disclose that there are in the United States and Canada something like 600 radio broadcasting stations. Of this number, approximately 130 are using 500 watts or more. These stations are sufficiently scattered so as to blanket the entire country.

At first glance this would appear to be a splendid thing—six hundred broadcasting stations putting as many programs on the air day after day. Surely one need never worry about picking up an enjoyable program, in view of the variety offered by the combined efforts of the broadcasters. But unfortunately, this is one case where quantity is of secondary consideration if, in truth, it is not of the very first consideration. With so many high power stations there is, if receiving conditions are good as in the cold, crisp winter evening, a considerable overlapping of wave lengths and, as a result, more or less interference. Hence the listener in needs a high grade set in order to pick out any particular station and bring it in so that the quality is good. This is especially true if he is located in the vicinity of one of the undesirable stations.

Then, to make the situation worse, the public is bent upon long-distance reception. Why it is essential that we listen to the impossible program of the Podunk Fire Department's band playing from the Podunk station when the nearby station is broadcasting Paul Whiteman's famous dance provocatives, would be a deep mystery except for the fact that Podunk is 2281 miles distant. Distance lends enchantment. And there you are.



Simple internals of the Armstrong super heterodyne receiver. Note the small loop which intercepts the radio wave

In an effort to obtain distance, in too many cases the listener tries to get stations that are beyond the proper capacity of his receiving apparatus, which results in forced regeneration in what is known as the regenerative receiver. Forced regeneration causes the receiver to act as a miniature transmitter which emits a radio wave of about the same wave length as the station that is being listened to with more or less success. Meanwhile, other listeners-in within a quarter of a mile or more are picking up the emitted wave which now gives rise to a whistle in their head phones or loud speaker. This case multiplied by dozens of others in the case of a small community or by thousands in the case of a large city results in a bedlam of whistles, groans, shrieks and whatnot which break up the radio programs for many of the radio audience. Unfortunately for the past two years our short sighted radio manufacturers have flooded the country with regenerative sets of the most offensive types.

In many localities the condition in this respect is deplorable. Broadcasters who take particular pride in their efforts are greatly discouraged over this situation. The worst offenders in the production of these radio birdies are the builders of crude home made sets. Sad to relate the regenerative receiver is the simplest, cheapest and most effective type of receiving apparatus for the efforts of the amateur builder. To make matters still worse the irresponsible dealers in radio equipment are forever dressing up the old regenerative receiver in some slightly different style and selling the parts to the gullible public under a new and high-sounding label. Were the regenerative receivers to be placed only in the hands of skilled and conscientious radio amateurs, there would be little if any of the unbecoming noises now heard, for truth to tell the regenerative receiver when properly operated does not emit a disturbing wave. In Great Britain where our trials and tribulations as pioneers in this radio broadcasting art have been carefully studied a regenerative receiver of any kind is positively tabooed.

A Better Receiver or More Powerful Transmitter—Which?

What is the remedy for this condition? That is a question which broadcasters and the radio industry and listeners-in have been asking themselves. In truth this is the gravest problem which confronts the broadcasters, apart from the economical side which is quite another story.

There seem to be two remedies available in solving the present state of the air: first, the use of receivers which will not and cannot emit a wave of any kind; secondly, to bring the transmitter nearer to the receiving set either by piling on more power in our present broadcasting stations or by installing more broadcasting stations at various points nearer to the listeners-in and operating these stations as repeaters of a single program sent out from some central or primary station.

Maintaining its pioneering spirit in the broadcasting field the Westinghouse organization has taken the initial step toward solving the present situation through the transmitting end. Instead of placing the burden on the radio audience, this organization has been working out a means of bringing the programs nearer to the receiving sets.

Here is how the thing can be done. Suppose we have a studio in New York broadcasting the finest type of programs. In order to bring those programs within reach of the listeners-in throughout the Middle West, let us say, we must operate a powerful station somewhere in the Middle West. The same programs are to be re-broadcasted from the Middle West station which is therefore a repeater station. Two methods are available for performing this service: one by telephone wire transmission between the New York studio and the Middle West repeater transmitter and the other by the special wireless transmission of the programs—quite distinct from the regular broadcasting wave—the special waves being intercepted at the repeater station by means of a suitable receiver and then fed to the transmitter for re-transmission.

Now imagine if you will, a number of these repeater stations located throughout the United States. This arrangement would give the radio audiences in every part of the country the finest programs available indirectly from the Gay White Way or from the Nation's Capitol, in ample volume so as to be intercepted with the simplest receiver. Obviously the repeater station

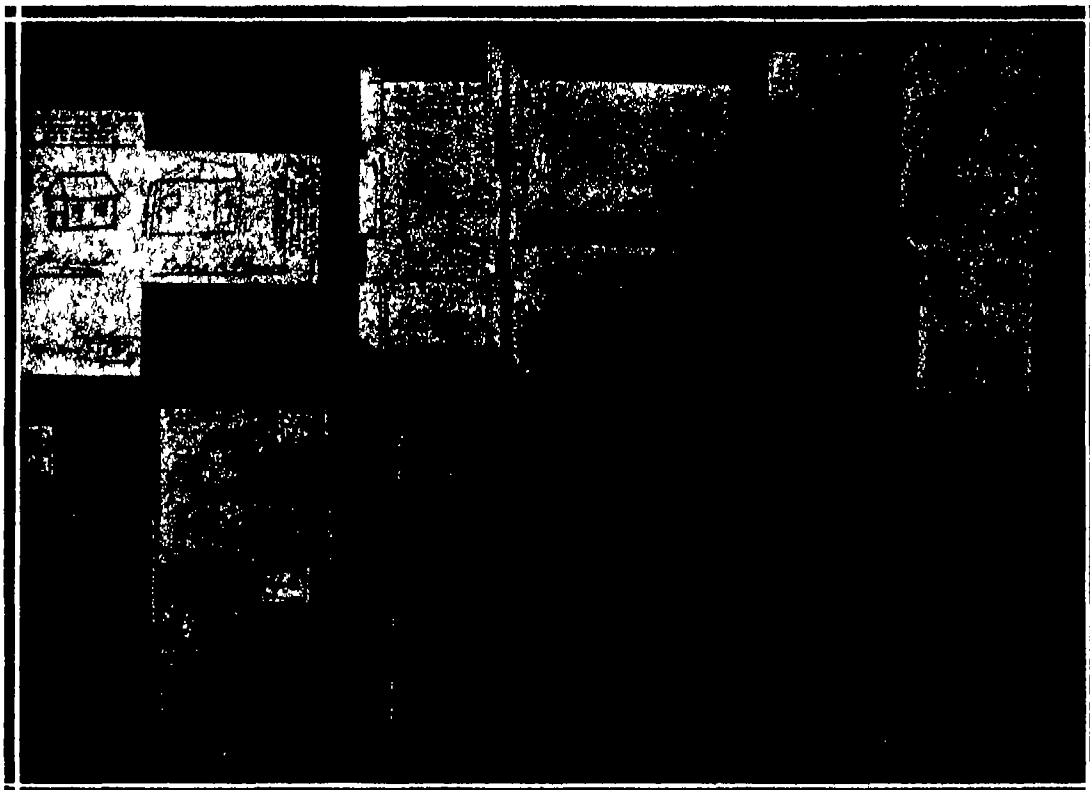
(Continued on page 338)

Experimental Telepathy

Tests by Dr. Carl Bruck, M.D., Berlin, on the Transmission of Drawings

Adapted by Dr. Alfred Gradenwitz from the Investigator's Report

NUMEROUS investigators have been attracted by the possibility that there exists, apart from the normal channels of communication through the recognized senses, a means of contact between human minds, a means for the interchange of information and ideas of such sort as to make appropriate the use of the word "telepathy" in characterization. Of those who have entered this belief some, like Coover of Leland Stanford, have concluded that telepathy does not occur, the apparent instances to the contrary being due to coincidence on the one hand or to the unrecognized (and sometimes hyperesthetic) operation of the ordinary senses on the other. Investigators of the British Society of Psychical Research on the other having taken due precautions against these factors, still obtained results that indicated the passing of information in some way, which they considered it permissible—or even perhaps necessary—to recognize as telepathic.



The numbers pencilled upon the corners of the originals identify these: plain numbers 1, 2, etc., are the drawings made by the experimenter while numbers suffixed by a, b are the reproductions made through a process presumed to be telepathic by the subject or subjects. For full description, see the text

Six of Dr. Bruck's most striking apparent successes in telepathic transmission

Admittedly the more startling instances of apparent telepathy are quite spontaneous, and save by the rarest good fortune inaccessible to the investigator. Admittedly the attempt to produce the phenomenon experimentally works under grave disadvantages, as compared with the spontaneous operation of the telepathic faculty. But if when we say "telepathy" we mean simply a clairvoyance in space or time, or both, operating in a fashion not defined, there seems excellent reason to believe that this may occur both spontaneously and less reliably, under experimental conditions.

Perhaps the most ordinary mechanism for experimental telepathy is that in which ideas are fixed by means of rough pictures drawn by one experimenter which the other experimenter attempts to reproduce under conditions of isolation against all normal communication. The attempt to secure such isolation is not a simple one. The investigator assumes an exceptional degree of scientific and moral responsibility for such sources of error as, apart from conscious and unconscious fraud by the subject, may be due to illusion on the part of the investigator himself. In my own experiments I have attempted to gain security against this sort of thing by keeping the drawings in portfolios throughout the test, so that they should be visible to *nobody* while in the cases where this was not done every precaution was taken to insure that there should be no visibility of the drawings to the subject, either directly or through reflection. Former experimenters have dealt satisfactorily with such obvious things as mirrors, pictures and window glasses, but they seem often to have overlooked the much more universal reflection on the cornea of the investigator or possibly, on his eyeglasses. When such reflections exist it need not be asked whether their perception by the subject would be conscious or unconscious, whether it would be entirely normal or would involve a visual hyperesthesia.

Objections to the use of drawings prepared by myself and known to nobody else were frequently met by tests with pictures improvised on the moment by other persons present. Such factors as the help possibly derived from motive automatisms of experimenter or spectator (unconscious whispers, animating mimics, gestures, etc.) likewise had my attention and I feel that I can guarantee that none of my results were due to "muscle reading." The sittings were under the control of members of the Berlin Medical Society for Psychic Research. No mystic ritual was observed—there was no expectation affecting the mind, but likewise no intimidation or aggressive skepticism, liable to hamper the subject's psyche. Fraudulent maneuvers were never observed, all objections and reservations were invariably recorded, even though their futility were immediately realized. Particularly was the choice of too commonplace motifs for the drawings avoided, as well as those which, like the distinction between "yes" and "no," involved too simple a choice. It would seem that in any experiment to which it is hoped to attach significance, the topic present in the mind or on the paper of the experimenter should be of such sort as to offer the subject in general terms a hundred or more alternatives. Any conspicuous success will then defy explanation on the ground of chance coincidence.

The four persons experimented on in the tests here reported showed intense scientific interest, without any improper secondary intentions. They were young men between 18 and 24 years, civil servants or employes. One never returned after his first (negative) test, a second died after two very fine positive trials. The third, Mr. Z., submitted to 19 tests, but the bulk of the work was done with Mr. R., an unsalaried clerk of 18 in an optical institute. The tests were mostly made under hypnosis, and all four subjects proved easy to hypnotize. Alternating tests with and without hypnosis were made, and very good results were obtained in simultaneous tests with R and Z both having their attention centered on the same drawing.

The experimenter's role was limited to a brief indication that on intense concentration upon the original, this would make its appearance in the subject's internal perceptive field in such manner as to be readily recognized and copied. The results were made known to the subject and to the others present only *in toto*, at the termination of the sitting, for an immediate announcement of failure is known to hamper the psychic mechanism of the following numbers on the program. Short intervals were allowed between each two individual tests, nevertheless, fatigue was marked toward the end of each sitting.

The summation shows that of 108 sittings, 20 gave positive results, 32 results of more or less partial satisfaction, and 56 were negative. Two cases of failure should be eliminated as due to voluntary or involuntary suggestion from me. Inasmuch as there is not space here available for complete display of all these tests, only the more remarkable cases will be discussed here. Readers who desire more complete information are referred to the more complete report which will appear in book form (Julius Puttmann, Stuttgart), an English edition of this volume is contemplated.

The very first tests, two in number with Mr. I (the subject who died) were in the deepest somnambulistic hypnosis. These were "open" tests and in addition to the ordinary precautions against "mirror telepathy" the subject was seated at right angles to the experimenter rather than opposite him. Referring to this test, Figs. 1, 1A show a surprisingly faithful copy of a house with gabled roof, door and two windows. No importance, of course, is to be attached to correct drawing, the main point being the inclusion of the whole, or of one or two dominant features. On dehypnotization the subject showed complete amnesia, not being able to identify the house which he had copied even when confronted with the original.

In the case (Figs. 2, 2A, 2B) where the original consisted of the character 6, the positive result of Fig. 2A is slightly disguised by a somnambulistic automatism following closely upon the initial success. After the six had been properly copied, an auto-suggestive impulse to further drawing ensued, probably analogous to automatic writing or automatic art. The somnambulistic automatic component is distinctly seen to follow after the telepathic one, and a similar sequence was eventually noted, repeatedly, in the case of Mr. R especially.

Figs. 3, 3A, 3B and 4, 4A, 4B—ladder and cup—are portfolio tests with R and Z in simultaneous hypnosis. Mr. R., to whom the A figures pertain, was the more gifted here, from the artist's view, and automatic additions are found in the pail and the spoon, whereas Mr. Z renders only the elements of the original, omitting even the saucer in 4B.

Figs. 5, 5A, come from a portfolio test with Mr. R. on a drawing rapidly improvised by one of the spectators in an adjoining room. Besides a reproduction accurate to the very details of the liqueur glass, there is here an automatic addition, eventually identified as a record from the mind of a little boy belonging to Mr. R's circle of acquaintances.

All further figures are from tests with Mr. R. In 6, 6A, such details as the wart, the deep folds of the upper lip and the sectional view of the right eye, are particularly evidential. This, like 7, 7A, 7B, was a portfolio test, offering no opportunity whatever for conscious or subconscious fraud. In the case of Fig. 7, we have, respectively, the result from using the same original with successive tests in and out of hypnosis. The subjects could not know that the same original was used, even if we ignore the fact that he was in hypnosis the first time.

The rhomboids of Fig. 8 illustrate admirably the

AS THIS issue goes to the compositor, we are perfecting plans for an experiment of our own similar to Dr Bruck's, but covering a very much greater ground The experimenters will work from the WOR broadcasting station in Newark, and every member of the radio audience who is sufficiently interested may become one of the 'subjects' by the simple process of listening in We shall have the experimenters concentrate upon a succession of numbers words objects, pictures, etc, and we shall ask the subjects' to try to get an impression of what these are, to record these impressions, and to report to us by mail We should have a number of responses sufficient to make possible a severe statistical treatment of the results, which will be made public in the earliest available issue of the SCIENTIFIC AMERICAN—*that of June if the work of compilation is not too arduous, otherwise that of July*—THE EDITOR

reproduction of the characteristic outline of the original That this does not always occur, however, but that the subject's work may be limited to some significant individual element, appears in Fig 9, serpent Let the reader examine the thick head and the tapering half of the tail, the checkered central piece was missing and has been filled in by me One can easily get here the impression of a defect in the field of meta psychic vision Being a portfolio test behind the subject's back, this is of particular interest, the more so since the same original was repeated, three times, with the same curious result—the subdivision and gap in the telepathic drawing persisted

Fig 10 (scissors) shows a methodically continued series of tests from the same original The component elements, the scissors-handle, were reproduced first as dumb-bells and then as pince-nez, and in the final test, made on Mr R's express desire because of his only now having the feeling that he was sure of himself, *the original appears in its totality with much* wealth of detail

Numerous experimenters have reported a sort of telepathic lag in which the drawing upon which a failure had but just been scored would be successfully reproduced in connection with the next item taking the place of the true original provided for this and occasionally this lag extends over an even greater interval than consecutive tests. I have had five instances of this but in Fig 11 I illustrate the direct reverse phenomenon In this case the original was a bottle and the subject drew something *like a hat* But I was struck with the likeness between the top portion of the original, the stopper with the bottle-neck, and the hat as drawn so I requested Mr R to go on drawing He then left the hat *in statu quo* and proceeded to make a new drawing below it, of the top of a street lantern, and this corresponded in every detail to the original waiting in the portfolio, for the next test If the displacement in time is to be regarded as a telepathic phenomenon the anticipation and the lag must be dealt with and accounted for together

A metapsychic explanation of anticipation and deferment has been attempted on the hypothesis that during the sitting the subject has telepathic access to the whole experimental complex prepared by the investigator This, of course, is no explanation, but merely an alternative description of the phenomenon, withal it seems a very reasonable description.

In Fig 12, a candlestick with candle was first rendered as a letter balance, it might be disputed whether this was a complete or only a partial failure But an hour later, when the failure had been made known, Mr R insisted upon a repetition, and faithfully reproduced the original *Whether this is a case of deferment or* of gradual solution of the task, across an approximate ing intermediate result, is left to further interpretation of the case (We assume that Dr Bruck may be trusted to have made sure that it was not due to the subject's having in the meantime seen the original —Editor)

Further illustrations are crowded out, but the results of several interesting tests may be described without pictorial representation A similar case to that of Fig 12 involved a soup ladle, which was first rendered as a key (the dissimilarity of outline is not so pronounced as this statement might imply—Editor), later, in a repetition at Mr R's insistence, the original was reproduced with great accuracy

In some instances a rather complicated picture was used, and a description in words asked for rather than a drawing Thus two fighting cocks facing, one an other one being grayish black and the other brownish yellow, brought out a reference to a 'black fowl' Told that the success was but partial, Mr R asked to make the test in drawing, and produced two conventionalized curved figures in outline which could be reconciled with *the cocks if one were determined to do so but of which* a more accurate estimate would be that their symbolism could not be identified Over these he ultimately wrote the words 'gray' and 'yellow,' in the correct order The existence of two separate figures of unusual outline had been apprehended with their color the exact rendering of their shape had been quite properly, subordinated In connection with another descriptive test employing a black and white drawing of spring scenery with shepherd and shepherdess, Mr R saw a colored scene of autumnal character, with a farm Moderately *satisfactory as showing comprehension of the general* effect this is again inadequate in detail, the test ought perhaps have been continued

As long as we can do nothing better than hazard vague guesses as to the psychic process involved in per*formances of this character any such interesting details* of the phenomena must be carefully kept on record But so far from suggesting any new hypothesis of telepathy, experimenters as a rule, should be content with simple queries Thus following Prof Oesterreich we may ask

'Is it a case of direct television or clairvoyance by the subject with regard to the object (the drawing for example), without any active cooperation by the experimenter or any other agent?

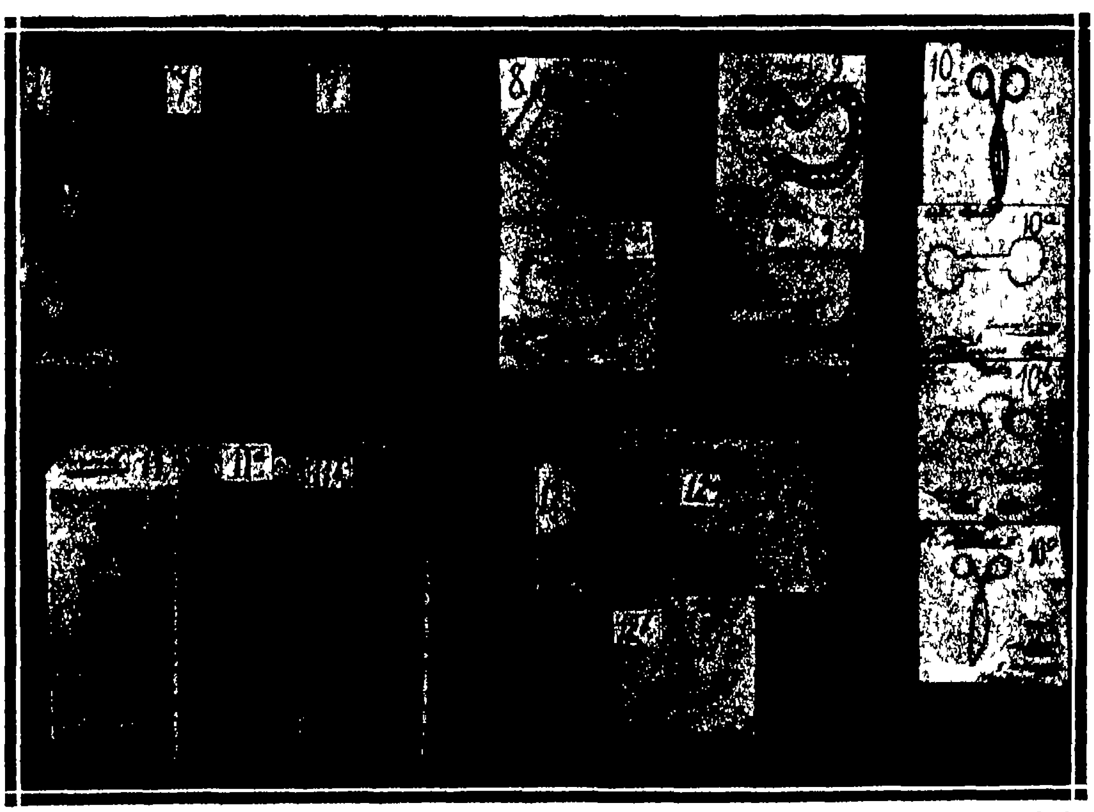
'Or is it possibly some sort of physical transmission of the physiological process of vision or perception from the experimenter to the subject?

Or finally, is it a psychic process arising from sources so far inaccessible to our understanding?

Only in the event of telesthesia as well as all other occult phenomena being due to an exclusively cerebral function would it be possible to adopt an exclusive psycho physical viewpoint or even on a purely physical basis to imagine radiations of some sort from the brain as carrier of the telepathic faculty But this exclusively cerebral activity has not been generally acknowledged, even for the psychic phenomena of the conscious *mind and this lack of* knowledge is clearly seen when Richet employs for the telepathic phenomenon in its entirety the term "cryptesthesia"—a term which amounts in substance to a clearly stated '*ignoramus* The number of original tests by those primarily fitted for the task is inadequate, the *theory must therefore of necessity be inadequate*

In conclusion a word should be said of the weak point met in all fields of psychic research—the absence of satisfactory results in control and demonstrative tests which would not in all cases seem to be disposed of by the hypothesis of emotional psychic impediments such as often do make themselves felt The fear of failure inadequate mental contact with the subject, temporary absence of the usual experimenter, we know from the normal experience of normal psychology are likely to lead to failure With many subjects, individual sug*gestibility is bound to bring about a condition of super*preparedness and enhanced telepathic productivity with regard to customary and sympathetic suggestions, which under other conditions may be lacking In the case of Mr R, despite a continuous excellent contact with him a whole series of failures was often observed under what appeared to be the usual conditions The intimate cause of such temporary psychic indisposition will not for the present be understood any further than, speaking generally the similar temporary indisposition is understood in connection with all intellectual activity—and especially with artistic, inspirational activity The fact is that all artists both productive and reproductive, whose achievements are strongly emotional show just this periodicity of effective work

The part possibly in addition to conscious will and possibly not, assumed by feelings and emotions sensations and perceptions in telepathy as well as in other metapsychic phenomena has yet to be ascertained The exhaustion observed even by *myself and* sometimes by the very spectators toward the end of a test sitting the feeling of disinclination possibly connected therewith should to some extent account for the presence of temporary disability Constitutive factors should doubtless be considered as well puberty marriage climate constitutional health and specific disease infections possibly even a change in the social medium The suggestion of good faith inherent in the variability of these perhaps the most trying of all the phenomena of the mind is far too strong to be thrown aside at a word from the thoughtless critic We should expect success to be capricious and we find it so



Another series of tests in which the "telepathically" received impressions of the subject checked up well with the originals

Putting the Atom to Work

The Attempt to Isolate its Energy, and to Find How it May be Released for Human Use

By Sir Oliver Lodge, F R S

THE atomic weight of hydrogen is not exactly 1 but by careful measure ment is found to be 1 0077 Who could imagine that in this slight dis crepancy—which indeed needs some explanation to make intelligible—an immense store of possible energy is indicated which some day when we have learned how may become accessible for good or ill to the human race?

Let us first expound the meaning of the statement For the bare statement that the atomic weight of hydro gen is 1 or nearly 1 conveys nothing whatever un less we know the unit in which it is measured that is to say unless we have something to compare it with For of course all measurements are relative to some thing

Well, it so happens that rather more than a century ago viz in the year 1813 (when the atomic theory of Dalton was ten years old) Prout made the observation that the atomic weights of all the elements as then ascertained, on the basis of taking hydrogen as 1, were too nearly whole numbers to be the result of chance, and accordingly made the suggestion that the outstanding discrepancies might be otherwise accounted for He surmised that they really were whole numbers, and not fractions so that possibly all the elements were multiples or aggregates of hydrogen

The hypothesis after exciting some in terest went into disrepute for a long time though admittedly a great number of the atomic weights as determined by chemists were very close to whole numbers But there were a few exceptions that could not be overcome of which the most notable was chlorine whose atomic weight was unmistakably 35½ and no contriv ance could make it 35 or 36 If it had been like potassium 39 1, or like iodine 126 9 a little contrivance or assumption of error in experiment would have al lowed these to be interpreted as whole numbers And there were many of the atomic weights in this reasonable posi tion But there were some that were re calcitrant not only chlorine but say sili con, which was 28 3, and magnesium, which was 24 3 And the outstanding fractions were more than could easily be got rid of Hence though there was something admittedly puzzling about the near approximation to whole numbers the hypothesis of Prout that all the elements could be built up of hydrogen, with the atomic weight 1, fell into discredit

Nevertheless it was not altogether killed For Sir William Crookes in 1886 at a meeting of the British Association in Birmingham made a suggestion that perhaps the elements were not such simple and well defined things, and the atomic weights not quite so numerically definite, as had been thought that what we call magnesium, for instance might possibly not be a single substance but a sort of average a certain proportion with atomic weight 24 mixed with another smaller proportion of atomic weight say 25 or 26—the proportion so adjusted that the combined weight should come out 24 3 or thereabouts In other words that the experimentally determined atomic weights were averages rather than exact figures though admit tedly chemical skill allowed these averages to be deter mined with surprising accuracy

It is worth while to quote Crookes's words in this connection published as they were so long before any verification was possible This is what he said —

"I conceive, therefore that when we say the atomic weight of for instance calcium is 40 we really express the fact that while the majority of calcium atoms have an actual atomic weight of 40, there are not a few which are represented by 39 or 41, a less number by 38 or 42 and so on "

This when thrown out was only a hypothesis a guess a suggestion Or as Crookes himself called it "an audacious speculation But like many of Sir William Crookes's ideas it was based upon an instinct not to be despised and was worthy of such testing as might be possible At the time no such method was "able The discrimination of the constituents of elements, on the supposition that there might be such constituents, could not be done by purely chemical means For presumably every constituent which grouped itself about the average value though it might differ slightly in atomic weight must have identical chemical properties Otherwise they would have been separated long ago, and not called by one and the same name

The possibility of the existence of such elements—of which the atoms differ in weight but in no other particular, having all their chemical properties exactly the same, and giving the same identical spectrum,—suggested itself to Professor Soddy in connection with his work on radioactivity And he called them *isotopes*, meaning that they occupied one and the same place in the chemical series of Mendelejeff This idea may be dated as of 1910 Soon afterwards in 1912 and 1913, a remarkable method of analysis by physical means in a vacuum tube was invented by Sir J J Thomson,—a method known as positive-ray analysis And this was forthwith applied in an improved form by that indefatigable worker F W Aston (who went from Birmingham to Trinity College Cambridge) with re markable and striking success, confirming to the hilt both Crookes's speculations and Soddy's half ascer tained results The simultaneous communication of these vital discoveries, with the assured conclusion that atomic weights were really whole numbers and that all the fractional part was due to a mixture of different whole-number isotopic ingredients, was made to the British Association at Birmingham in 1918, one to the Chemical and one to the Physical Section by Soddy and by Aston respectively 27 years after Crookes had thrown out his suggestion in the same city

Aston was able to show that chlorine, with its atomic weight 35½ or with greatest accuracy 35 46 was really a mixture, in unequal proportion of two elements exactly like chlorine and occupying the same place in the periodic table so that they could be appro priately called isotopes but of which the atomic weight of one was 35 and that of the other 37 the proportions being about three of the lighter to one of the heavier elements And again that silicon, with its atomic weight 28 3 was an admixture of two real elements, 28 and 29

Not all the so-called elements are mixtures Carbon, for instance is exactly 12 nitrogen exactly 14 Mag nesium is a mixture of three, with atomic weights 24 25 and 26 And argon, though most of its atomic weight is 40 seems to have a slight admixture of a similar substance weighing only 36

But now on what scale are these numbers specified? What is the unit? Well the unit is such that shall make some one of these elements of simple constitution exactly a whole number and the scale chosen is that oxygen shall be 16 Then all the others fall into place. On that scale carbon is exactly 12 and helium exactly 4 But, strange to say hydrogen is not exactly 1 and no amount of contrivance can make it 1 It is 1 0077

How then can we say that Prout's ancient hypothe sis is substantiated or that there is any probability in the idea that the elements can be built up of hydrogen atoms? All we can say, so far, is that they appear to be built up of some units which can be counted, and which only occur as integers not as fractions Whether this something is or is not a hydrogen atom remains for further exposition

This exposition may be approached in two directions, both strongly confirmatory, one experimental, the other theoretical Perhaps we had better take the ex perimental one first, as it is the simpler of the two

The atoms are known to consist of massive nuclei surrounded by much lighter electrons Practically all the atomic weight is in the nucleus Even in hydrogen, which has the lightest nucleus, it is about 1850 times as massive as an electron Whereas, in a really heavy atom like uranium, it is 92 times heavier still Hence, when we speak of the atomic weight we mean the weight of the nucleus And if the atom is to be built of hydro gen, it must be that the nucleus is so composed No one imagines that the electrons have anything to do with hydrogen Hydrogen is a positive nucleus with one outlying electron And if the nuclei are composed of hydrogen it must be of hydrogen nuclei tightly packed together so as to form the compound nucleus of heavier atoms

It was known that these nuclei were small compact things, and that they were positively charged, but very little else was known about them until Sir Ernest Rutherford found a means of knocking them to pieces, and thus seeing what they were built of The only way to attack them is by their peers They could not be shattered or got at in any way by any such trivialities as high temperature, ex treme cold, enormous pressures chemical explosions or anything of that kind They were far beyond the reach of these trifling perturbations But the projectiles fired off by radium, at a speed of several thous and miles a second were not so insignifi cant And Rutherford arranged to bom bard the nucleus of any desired atom by means of these projectiles. They were targets excessively difficult to hit because they were so ultra minute and thousands of shots might go by them without achiev ing anything But then hundreds of thousands of shots were available, any number in fact so that sooner or later there was bound to be a hit And then something happened Briefly the nucleus broke up, and hydrogen flew out of it

The evidence for this must be read in Rutherford's papers The evidence is given for the propulsion of a quick flying hydrogen atom driven out of the nucleus by the bombardment

Well, this was pretty direct evidence that the nucleus contained hydrogen, or at least contained it in the same sense that water contains it For hydrogen can be driven out of water by an electric current, in that case, it is true, a very perceptible or possibly a large amount whereas, in Rutherford's experiments only one or two atoms are ejected But we are accustomed to deal with atoms nowadays and to recognize them individ ually And the evidence is sound It does not prove that the atom is built of hydrogen and nothing else but it proves that hydrogen is one ingredient What else was knocked out of it? Atoms of helium But we knew that atoms of helium were there before, at any rate in many atoms for they are spontaneously ejected during radioactivity Hence, it looks as if everything was built of hydrogen and helium

So now we have to consider what helium is built of Its atomic weight is four, exactly a whole number Hence, if hydrogen were 1, we should have little doubt that it was built of four atoms of hydrogen, very closely compacted together But the atom of hydrogen seems too heavy for that It is not 1, it is 1 007 How can we say then that four atoms of hydrogen can by any possibility build an atom of helium?

Well here comes the theoretical part of the exposi tion, the part which I said was rather hard We have now to enter upon the electrical theory of matter We know now that matter is electrically constituted, and that what we call its inertia is really due to the mag netic field of moving electric charges, that inertia is

(Continued on page 358)

THE series of drawings on the facing page which we employ as illustrations for Sir Oliver Lodge's article was obtained by Mr Clatworthy our artist, from Sir William Bragg's Christmas lecture before the Royal Institution Fig I represents the C. T R. Wilson cloud condensation apparatus, in the glass chamber of which clouds are formed and dispersed as in nature Its object (Fig II) is to render actually visible the tracks of the atoms that shoot off from a radioactive substance by condensing tiny globules of water upon these To explain these varied tracks, one must understand the complex structure of the atom as discussed by Sir Oliver and illustrated in Fig III

With a dummy billiard table (A center figure) and numerous balls representing atoms, Sir William demonstrated the relations existing when one ball attempts to pass through the cluster and demonstrated how empty the center of an atom must be to admit the passage of foreign electrons as it does. In the straight track of Fig IV the electrons have thus penetrated the air atoms; in the curved track of Fig V nucleus has collided with nucleus resulting in abrupt deflection

The lecturer explained the relation between chemical activity and atomic configura tion, the reasons why inert gases are inert, etc., but as Sir Oliver covers this fully in the present and a preceding article (SCIENTIFIC AMERICAN November 1923) we may pass it over here. Fig VI is for the purpose of showing that the phenomenon we know as heat is simply one of atomic motion The more a gas is compressed the closer to gether its atoms lie and the more frequently they will collide—causing the manifestation of heat.

The reverse (Fig VII center) also obtains, a gas cooling under expansion

In Fig VIII, sound waves demonstrably pass between the atoms. Thus these waves travel more quickly in hydrogen than in the denser oxygen.

The pressure of a gas is simply the bombardment of the surrounding walls by its atoms. The atoms of a gas can also obstruct those of a solid (Fig IX) or of a liquid (Fig X) In a solid, the constituent atoms are firmly united; in a liquid they are in touch but not permanently for they change partnership continually; whereas, in a gas all the atoms move about independently and arbitrarily

THE INTERNAL MECHANISM OF THE ATOM, AS DEMONSTRATED AT A RECENT LONDON LECTURE

Our Point of View

The Mischievous Pen

THE World War tumbled emperors from their thrones and placed the destinies of nations more directly in the hands of the people. A desirable change, provided the masses are kept fully instructed on matters of domestic and foreign policy. Under the old order the potentate was well informed, particularly on the international situation. His embassies and secret service saw to that. Today the masses, the great body of the voting population, are dependent for their knowledge of world affairs upon the press and more particularly upon the special correspondent and the so-called special writer.

In former days the emperor rattled the saber; today the press rattles the pen. Our war-stricken world understands, only too well, what evils may come of saber rattling, and unless the owners of the great journalistic organs of the day muzzle their correspondents, the world will find out to its infinite loss and agony, that the pen as a breeder of war may be even "mightier than the sword." But would you have the owner of a great daily muzzle his staff? Most assuredly we would to the extent of his laying it down as a law never to be broken, that the correspondent, special writer, or what not shall deal in facts only and not in his own sensational and war-breeding interpretation of the facts.

Of a vast number of the people it may be said that, once they have left the public school their sole source of education is the daily newspaper. They read nothing else unless it be an occasional novel from the nearest Carnegie library. And such people (whose ordered education ceased with the public school) have a pathetic faith in the infallible authority of the press.

"I saw it in the paper"—and that settles the matter. Hence the masses of mankind are made to believe that Japan dreams of capturing our Pacific coast; that France aims at the military domination of Europe, that Germany has secretly re-armed herself with a huge aerial fleet and is ready to drench Europe with poison gas. The King of Spain pays a friendly visit to the King of Italy and forthwith your European correspondent pictures a new European bone of contention—the control of the Mediterranean. The Caliph is expelled from Constantinople: next day you are assured that Great Britain would have an Arabian Caliph, France a Moroccan, and that herein lies another cause of friction and ultimately of war.

Helium as a Life-saver

A CORRESPONDENT very properly takes us to task for not having mentioned, in our recent article on the 'Shenandoah' that she uses helium instead of hydrogen. The omission was due to familiarity: to think of "Shenandoah" was, for the writer, to think of helium, and so familiarity bred not contempt but omission. As a matter of fact the writer considers that the most distinctive feature of the ship is the helium that lifts and supports her. To this remarkable gas she owes her great superiority over all other airships. She cannot be rent asunder by explosion nor can she suddenly be converted into a flaming funeral pyre for the whole of her officers and crew. To realize what this means we have only to call to mind the horrible fate of 'ZR 1' at Hull, England, of "Roma" at Hampton Roads, and of "Dixmude" off the coast of Italy.

Lightning destroyed the "Dixmude", sparking, of static or broken wire origin set fire to the other two and it is a fairly safe guess that had "Shenandoah" been filled with hydrogen when she was torn from her mast, there would have been another holocaust to record. For when the ship broke loose several things happened simultaneously. Not only were a dozen longitudinal girders torn asunder, but the steel landing cables and their winches were pulled out of the ship and the two forward gas bags were torn open. The violent rupture of all this metal work must surely have been accompanied by frictional sparks and this occurring in the presence of liberated hydrogen would probably have resulted in fire or explosion, or both. Surely it is not claiming too much to say that it was her helium that saved 'Shenandoah' and her crew from instant and overwhelming disaster.

Against the advantage of safety is to be set the scarcity and cost of helium and the fact that its lifting capacity is about 7 per cent less than hydrogen. The operating losses of the gas may be reduced by recovering the water from the engine exhaust, and maybe, though this is at present impossible, by some method of compressing the gas into cylinders instead of venting it into the air.

The Good Old Times

THERE is a romance about the past which finds expression in the phrase 'the good old times.' But, outside of their leisurely ways as compared with our modern rush, are we sure that these old times were so very good? Listen to the following, culled from our contemporary *The Engineer* which refers in a recent issue to an address, given in 1864 by the President of the South Wales Institute of Engineers when that gentleman described the shocking conditions attending coal mining in Scotland prior to the year 1800. It seems that the collier left home at eleven in the evening and prepared the coals by "hewing them down from the wall." His wife and daughters followed him three hours later and descended the pit with baskets, which they filled with coal and carried on their backs to the pit bottom, the mother going first with a lighted candle held between her teeth. From the pit bottom these women carried their loads up the steps to the surface, and in eight to ten hours' time one woman might carry through the mine and up to the surface a total load of two tons, traversing a distance of nearly six miles, and climbing one hundred feet by the stairs 24 times in succession.

Such were the good old times of the middle of the eighteenth century, when a man was hung for stealing a sheep and lesser infractions of the law were rewarded on the same ferocious scale. If the thoughtful among us speak of the good old times, it is because we are conscious of the high pressure and unending strain of our highly industrialized civilization. In such a mood one may long for the comparative quiet and restfulness of far away days. But what would Shakespeare have to say, if we could bring him back to life, take him into the subway jam during the morning or evening rush hours, and let him be catapulted by the center rush into a tightly wedged mass of humanity in an Interborough car? Or let us bring the great Dr Johnson from his London Coffee House, and take him for a stroll down Broadway in the closing hours of the Wall Street district. "Sir," he would say, "I have turned over many an anthill with my boot, and seen no stream of insects to equal in numbers and density this outpouring of humanity from your Brobdingnagian buildings. Whether in play or at work, you swarm as do the bees, and of distinctive individuality I see no very marked signs."

Panama Canal Sufficient

WE have had occasion to point out the fallacy of claiming that because of the recent rapid increase in the traffic passing through the Panama Canal, the United States should begin to consider the construction of a second canal, preferably at Nicaragua. It is questionable whether Nicaragua would prove to be the most desirable location. The great length of the route and the engineering difficulties arising from the topographical conditions, to say nothing of its nearness to the earthquake zone, combine to cast a serious doubt upon such a project. The cost moreover would be prodigious.

To tell the truth there is no question of the ability of the Panama Canal to take care of future traffic for many decades to come. In spite of the gratifying growth of traffic, the canal as it stands has a wide margin of capacity. Even under its present limited hours of operation there is room for considerable increase in shipping, and when it is thrown open for night traffic and is in service for the whole twenty-four hours of the day its capacity will suffice for any probable increase in the near future.

When the time comes for enlargement of facilities, it will not be necessary to go elsewhere. By building an additional pair of locks, adjacent to those at Gatun, Miraflores and Miguel, and building a new reservoir at Alajuela, in the upper Chagres river, the capacity of the canal of that day may be doubled, and all anxiety for the future removed to a far distant day.

The recent remarkable increase in the tonnage passing through Panama has been due, mainly, to the opening up of certain very rich oil fields, mainly in California, and the fact that the oil can be carried to the Eastern refineries via the canal more cheaply than by any other route. These western oil fields have about reached the peak of their production and future canal traffic may be slowed down by the withdrawal of these tankers.

The Oil Delusion

THERE is no money in oil (now please do not get excited), except for the very few. This is a startling statement and we would not make it except upon the best authority, which in this case is the U S Geological Survey. As their leading geologist said to the Editor the other day "Oil producers, as a class, lose money, though some make lots of money," and he went on to say, "that, by and large, including the 'wildcat' ventures, it costs more to get oil to the customer than the customer pays."

Consider the State of Oklahoma, where, a few weeks ago, oil was sold at $1.75 per barrel. To begin with, the prospective millionaire must pay out on an average $40,000 for drilling his well, and it will cost him about 15c per barrel to raise the oil during the flow. Pumping, on an average, will cost him from 80c to $1.00 per barrel. He must reckon in the interest on his investment of $40,000, and the well must pay its share in the general overhead of the company. Also it must pay its share of the original cost of the lease. Finally, all of the above items have to be taken from seven-eighths of the oil, since one-eighth, let us say, of the oil goes to the lessor. This estimate of seven-eighths of the oil to the operator is very liberal, for in some cases the terms may be drawn on a basis of as high as one-fifth of the oil to the lessor. By the time these costs have been deducted from the $1.75 received for the oil, we are prepared to believe that the "money from oil is made from the crude at the well on to the consumer."

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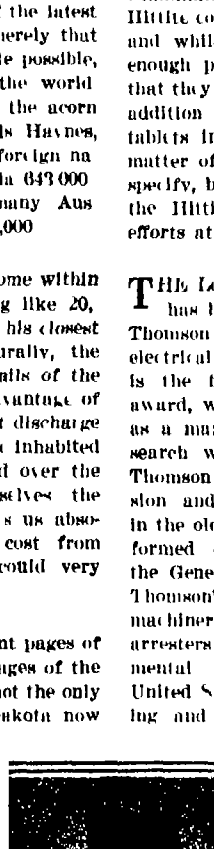
Here and There

SOME months ago we saw statistics indicating that the number of cars stolen each year in a group of leading American cities exceeds the total number in operation in countries as important as Japan and Czecho-Slovakia—several others were named, but these two alone we remember. We decided at the time that this was the most picturesque and convincing demonstration that ever had been or ever could be made of the unchallenged place of the United States at the head of the motoring world, and that we should never again try to illustrate this point by any other citation of figures than this one. So in the presence of the latest automobile census, as of 1923, we remark merely that there are today, by closest count and estimate possible, 18,241,477 automobiles in use throughout the world. It's a mighty big oak that has grown from the acorn planted two decades ago by Messrs. Ford, Olds, Haynes, Duryea, Rolls, Panhard, et al. Among the foreign nations, Great Britain has 655,000 cars, Canada 643,000 and France 400,000. In three others—Germany, Australia and Argentine—the totals exceed 100,000.

DURING the coming summer Mars will come within 31,000,000 miles of the earth, something like 20,000,000 miles nearer than is his custom and his closest approach in more than a century. Naturally, the astronomers who are interested in the details of the Martian geography are preparing to take advantage of the occasion; and a lot of people who cannot discharge their minds of the suspicion that Mars may be inhabited are getting as excited as could be expected over the prospect of proving their case. For ourselves the question of communication with Mars leaves us absolutely cold. Whatever the attempt might cost from ten cents to twenty million dollars, we could very easily spend in a better scientific cause.

THE dinosaur eggs which occupied the front pages of the newspapers and one of the inside pages of the SCIENTIFIC AMERICAN, not so long since, are not the only prehistoric things of their kind. South Dakota now comes to the fore with a collection of fossilized eggs, turned up in her 'bad lands' by Professor H. W. Nichols, assistant curator of geology at the Field Museum, Chicago. These are very much smaller than the dinosaur eggs, being the product of a small bird apparently bearing some resemblance to the duck of today. The photographer who supplies Professor Nichols' picture qualifies for honorable mention by informing us these duck eggs are believed to be older than any other relic of animal life now existing with the exception of the dinosaur eggs from Mongolia.' As a photographer, however, he is reliable despite his weak geography; we have no hesitation in presenting his print as really representing the face of Prof. Nichols!



Prof. H. W. Nichols

ONE of the most active inventors among the scientists of the day is the sharp-faced individual at the lower left corner of the page—Dr. William W. Coblentz of the Bureau of Standards. If Dr. Coblentz were to be characterized professionally, it would probably be as an astro-physicist. One of his particular specialties is the study of the heat radiated from the stars and planets and in this field he has devised most of the standard instruments now in use. The photograph shows him squinting into the eye-piece of a radiometer so sensitive that it will detect the heat given off from a candle at a distance of three miles. Is it any wonder that with such an apparatus, Dr. Coblentz can measure the heat which we receive from individual stars? We rise to remark that the Doctor carries his fifty years very well, if one may judge from his picture.

Dr. W. W. Coblentz

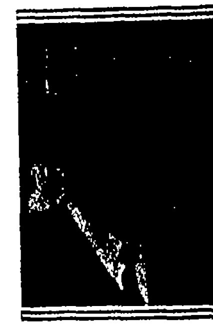
ALLUSIONS to the siege of Troy are contained in inscriptions on ancient clay tablets dating back a dozen centuries before Christ, according to German investigators who have these tablets in charge and under examination in Berlin. The tablets brought from the Hittite country by Hugo Winkler are 11,000 in number, and while not completely deciphered have given up enough proper names to lend support to the theory that they deal with Troy and other Homeric topics. In addition to the famous siege, it is believed that the tablets include texts of treaties and other historical matter of prime importance. Our informant does not specify, but we presume that the language is that of the Hittites, which up to this date has defied all efforts at translation by modern scholars.

THE Lord Kelvin Gold Medal for 1924, has been awarded to Professor Elihu Thomson, one of the world's most eminent electrical engineers. Professor Thomson is the first American to receive this award, which is made every three years as a mark of distinction in original research work in engineering. Professor Thomson got an early start in his profession and was one of the moving spirits in the old Lynn, Mass., shops which later formed one of the integral parts of the General Electric combine. Professor Thomson's inventions in dynamo-electric machinery, electric welding, watt-hour meters, lightning arresters and magnetic arc extinguishers are fundamental; and in all, he has been granted about 700 United States patents. He was a pioneer in arc lighting and innumerable electrical devices have been improved through his work. In addition to his research work, he has always been active in educational circles, having started in the Central High School of Philadelphia, and being now identified with the Massachusetts Institute of Technology. The Lord Kelvin Medal is merely the latest of numerous similar honors which have come his way.

Prof. Elihu Thomson

NUMEROUS are the ambitious souls who visualize the immediate commercialization of the airplane upon a large scale, so that regular passenger service between New York and San Francisco, London and Australia, Paris and the heart of Africa, may be looked for by nine o'clock tomorrow morning at the very latest. Well, we have the many short lines in Europe, of which those crossing the Channel are apparently the most prosperous; but when the distance covered begins to run up into the hundreds of miles, the commercial difficulties of the promoters begin to outstrip even the technical ones. Thus, the British Government has just gone on record as refusing to back a project for service to India and Australia, and as a result the promoter has had to abandon his scheme. Those who have contemplated trusting their money to such projects as well as those who would contemplate trusting them with their lives can well afford to look upon them more conservatively than is the custom. The plain facts are that we are not ready for long range airplane service on any more ambitious scale than that now followed by Uncle Sam in his transport of mail; and it will be an indefinite period before we are ready. For long distances it seems a safe prediction that the airship will precede the airplane in the successful commercialization of aerial navigation.

ONCE upon a time, in telling the tale of modern industrial chemistry to the layman, it was necessary to start with an explanation of why ammonia is one of the most essential of all manufactured chemical products, and a cornerstone of all chemical industries. Today we assume that the general reader knows so much, and we tell each story of further advance in the production of ammonia on its own merits, without reference back to the general problem of nitrogen fixation. Prof. Arthur B. Lamb, director of the chemical laboratory at Harvard and of the Fixed Nitrogen Laboratory in Washington, is the latest figure in the ever-progressing attack upon this problem. He has discovered a new catalyst—its chemical identity is not yet revealed—which will bring about the direct union of hydrogen and nitrogen, yielding, among other products, the precious ammonia, and in larger amounts than by older processes.



Prof. Arthur B. Lamb

THE subject of catalysis itself is one of chemistry's romances. Dr. Hendrick has called the catalyst the chemical go-between. Perhaps an equally pertinent analogy would be to call it the chemical lawyer, or even the chemical court of domestic relations. Two prospective litigants who simply cannot agree may—if the lawyers are the right kind—manage to agree through their lawyers. Two persons who believe it utterly impossible to live together in harmony find, in the presence of the skilled adjuster of domestic entanglements, that it isn't impossible after all. And two chemicals that will have nothing to do with one another under ordinary circumstances, if brought together in the presence of a third substance, will perhaps form a perfectly good union. The lawyer isn't used up, the judge isn't used up; both are available to bring about subsequent reactions. And the catalyst isn't used up either. It stays in the retort while batch after batch of raw materials are put in, and batch after batch of the finished product taken out. Platinum is one of the best known of catalysts, but there are plenty of others, and it is one whose catalytic properties have heretofore been unknown that Professor Lamb has unearthed.

WE ARE rather in the habit of looking upon the modern city as the haunt of man alone, and assuming that wild animal life must necessarily be confined to the rural sections. It is of course true that the game animals shun the residence of man; but none the less we have a very considerable spontaneous animal life in our cities, and this uncensused fauna makes its presence objectionably felt from time to time. "Huge Rat Bites Sleeping Infant and Fights Man"—so reads the headline of the morning paper this fine day in March. The text is not confined to the specific instance of the head, but quotes a Health Department official to the effect that the war against rats is hopeless. He estimates that New York has a rat population of 3,000,000; that no more than 22,000 of these rodents are killed annually by human agency; and that next to the fire hazard they constitute the greatest single source of property loss in the city. Mice and tramp cats are just two other examples to show that our cities are not quite so exclusively given over to human habitation as we are habituated to thinking. Nor is it at all unusual for these and other ordinarily shy species to display very keen fighting capacity when cornered, so that it is by no means a hyperbole to speak of the wild animal life of our cities.

The Story of Steel—V

Bessemer Converter, Where Air Performs the Major Process in Steel Making

IN chapter IV of the Story of Steel we saw that in the blast furnace iron was separated from iron ore by means of the fierce heat resulting from the combustion of coke, through which great volumes of heated air were continually being driven. The resulting metal, as it is tapped from the bottom of the furnace, is liquid cast iron, or pig, as the furnace man calls it.

Now, although cast iron is a useful metal in the constructive arts, its range of usefulness is greatly limited by the fact that, though its compressive strength is high, its bending and tensile strength are low. It lacks the ductility, toughness, elasticity, and all round strength of steel. The absence of these qualities is due to the excessive amount of carbon present as compared with that in steel. There is also an excess of silica, a constituent of sand and rocks, phosphorus, as used on the household match, sulfur which the 'kiddies' used to take (and may do yet for all we know) in 'sulfur and molasses,' and manganese.

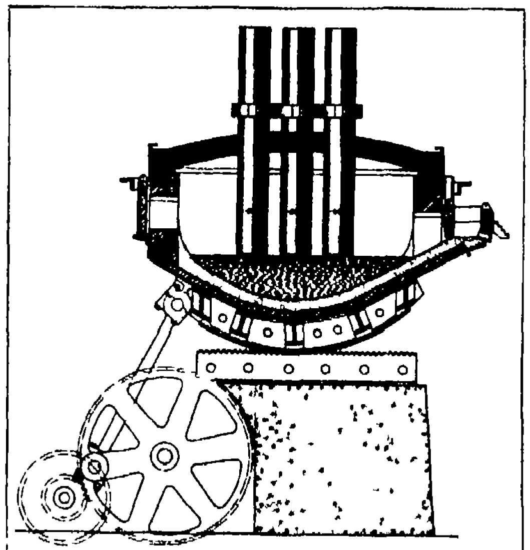
And as fire is used to get the iron out of the iron ore, so fire is used to turn the iron into steel. This it does by burning out the above named impurities either in the Bessemer Converter or in the Open Hearth Furnace. The Bessemer Converter developed in England by Henry Bessemer about 1855 was an epoch making invention in the steel industry. By many, because of its revolutionary effect on modern industry, it is regarded as the greatest of all inventions, for without it the production of cheap steel in unlimited quantities would have been impossible. It was admirably adapted to all ores that were low in phosphorus content. As the choicer ores became depleted the open hearth furnace of Siemens Martin was developed, and in this furnace ores that are high in phosphorus can be treated successfully. Today about 25 per cent of the steel is made by the Bessemer and 75 per cent by the Open Hearth method.

Steelmaking, as the editor recently saw it, is highly spectacular all the way from the vast open mines at Missabe to the rolling of the steel into its thousand-and-one shapes in the mills, but nowhere does it present such a dramatic and awe inspiring sight as in the converting mill.

The converter is a barrel shaped steel vessel varying from 10 to 16 feet in interior diameter, and from 12 to 20 feet in height. It is closed at the bottom and is drawn in at the top, as shown in the sectional view on the adjoining page. At its mid height it is supported on trunnions. An air pipe is led in through one of the trunnions and continues down to an air chamber in the base of the converter. The interior is lined with 12 to 18 inches of refractory material to protect the steel shell from the fierce heat. The bottom is perforated with from 150 to 200 one half inch holes, leading from the air chamber to the interior of the converter.

Now let us return to the blast furnace. Here, at intervals of every four hours, the clay plug which seals the outlet from the bottom of the furnace is broken through and the molten iron is run into a train of steel ladles, which are drawn by a locomotive to the mixer, a large horizontal cylinder lined with firebrick which can hold 1300 tons of metal at one time. The mixer here spoken of is part of the plant of the South Works, Chicago, of the Illinois Steel Company. The object of the mixer is to form a large reservoir from which the hot metal can be drawn as required by the converters.

From the mixer the hot metal is emptied by rotating the mixer on its axis and pouring its contents into ladles for transport to the converters. The converter is turned down into a horizontal position and a charge of 10 to 25 tons is poured in from the ladle. The air blast is then turned on and the converter swung back into the vertical position. The air, under a pressure of about 20 to 25 pounds to the square inch is now forced up through the molten iron in from 150 to 200 separate streams, and its oxygen combining with the carbon, silica and manganese in the iron sets up a violent combustion, and raises the temperature of the mass until it reaches the stage known as the boil. The process continues for from 10 to 15 minutes, at the close of which all of the impurities and practically all of the carbon have been burned out and only pure iron remains.



Section through the electrical furnace shown below. The current passing through the three 20 inch electrodes and the metal charge raises the temperature to as high as from 2850 to 3000 degrees

To the left is a 25-ton electric furnace, to the right a ladle is discharging molten iron into the furnace for treatment

The oxygen of the air first burns away the silica and manganese and finally the carbon. The color and density of the flame issuing from the mouth of the converter clearly indicate to the skilled operator what is going on inside. As the silica and carbon begin to burn an orange-yellow flame, edged with blue, streams from the nose of the vessel. Then as the carbon begins to burn there is a change to a bright flickering flame which rushes violently forth accompanied with great streams of sparks. Then the flame dies down. The process lasts only from 10 to 15 minutes, but the fierce combustion raises the temperature of the metal in that short time from 2000 degrees to as high as 3000 degrees.

We have spoken of the spectacular effect afforded by a converter mill in full blast. The agitation of the molten mass as the air rushes through it, produces a dull reverberation, which mingles its deep note with the steady roar of the hot and brilliantly colored gases, as they pour from the mouth of the converter. Every now and again small particles of white-hot metal are thrown high into the air and fall in a thick rain of brilliant coruscations to the ground. A good impression of these effects can be gained from the colored cover of our April issue which shows a converter in full blast.

But the mere burning out of the undesirable elements does not give us steel, for what we have left in the converter is merely an unadulterated and "characterless" iron. It must now be changed into steel by putting back into it, with great exactness, a certain amount of carbon, manganese, silica or other substances to produce the kind of steel required. Accordingly after the converter is turned over and before its contents are poured into a ladle, a carefully weighed amount of these substances in the form, let us say, of spiegeleisen, is introduced in molten form into the converter, to give the small amount of manganese, silica and carbon required in the finished steel.

The ladle is now lifted and a train of cast iron ingot molds with two or three molds to the truck, is drawn beneath the "pouring stand," and the steel is run into the molds through a nozzle in the base of the ladle.

The Bessemer converter has been replaced very largely by the basic open-hearth furnace, which is capable of handling satisfactorily iron made from inferior grades of ore containing large percentages of phosphorus. The Bessemer converter does its work upon the metal in from 10 to 15 minutes, whereas the open hearth requires from seven to 12 hours. Speaking broadly, the open-hearth process permits the metallurgist to keep in closer touch with the reactions that are going on within the furnace and, by skillful treatment, he is able to secure with accuracy the exact amounts of carbon, manganese, etc., necessary to give him the steel which he wishes to produce.

Excellent as the open hearth furnace process is, the steel maker has aimed to get even better results by using the electric arc as his source of heat in the furnace. Much experimental work has been done and out of this has come the Heroult electric furnace, of which we show a photograph and cross section on this page. The Illinois Steel Company have been very accurate and successful in the development and use of electric refining and the two 25-ton furnaces shown in our photograph are among the largest and most successful in existence. The United States Steel Corporation has four of these 25-ton electric furnaces, and the Corporation built two 40-ton Heroult electric furnaces for the United States Navy which operated very successfully during the war at the U. S. N. Ordnance Plant at So. Charleston, W. Va.

The furnace 16 feet in diameter, has a plate steel shell one inch in thickness. The bottom is carried on toothed rockers and tracks, on which the furnace is tilted to empty its contents. The large wheels shown are geared to a 140-horsepower motor, which tilts the furnace, by means of a connecting rod. The furnace is lined with three different materials, first 4½ inches of fire-brick, next to that a lining of magnesite brick 9 to 13½ inches in thickness and above the last named is spread about 18 inches of dead burned magnesite. The dome-shaped roof, 12 inches thick, is of silica brick.

In the roof are three equally spaced openings for the electrodes, 20 inches in diameter, which are formed of amorphous carbon. They are carried by horizontal arms that project over the furnace from heavy, vertically moving rods. Heavy copper cables and copper bars carry the current from

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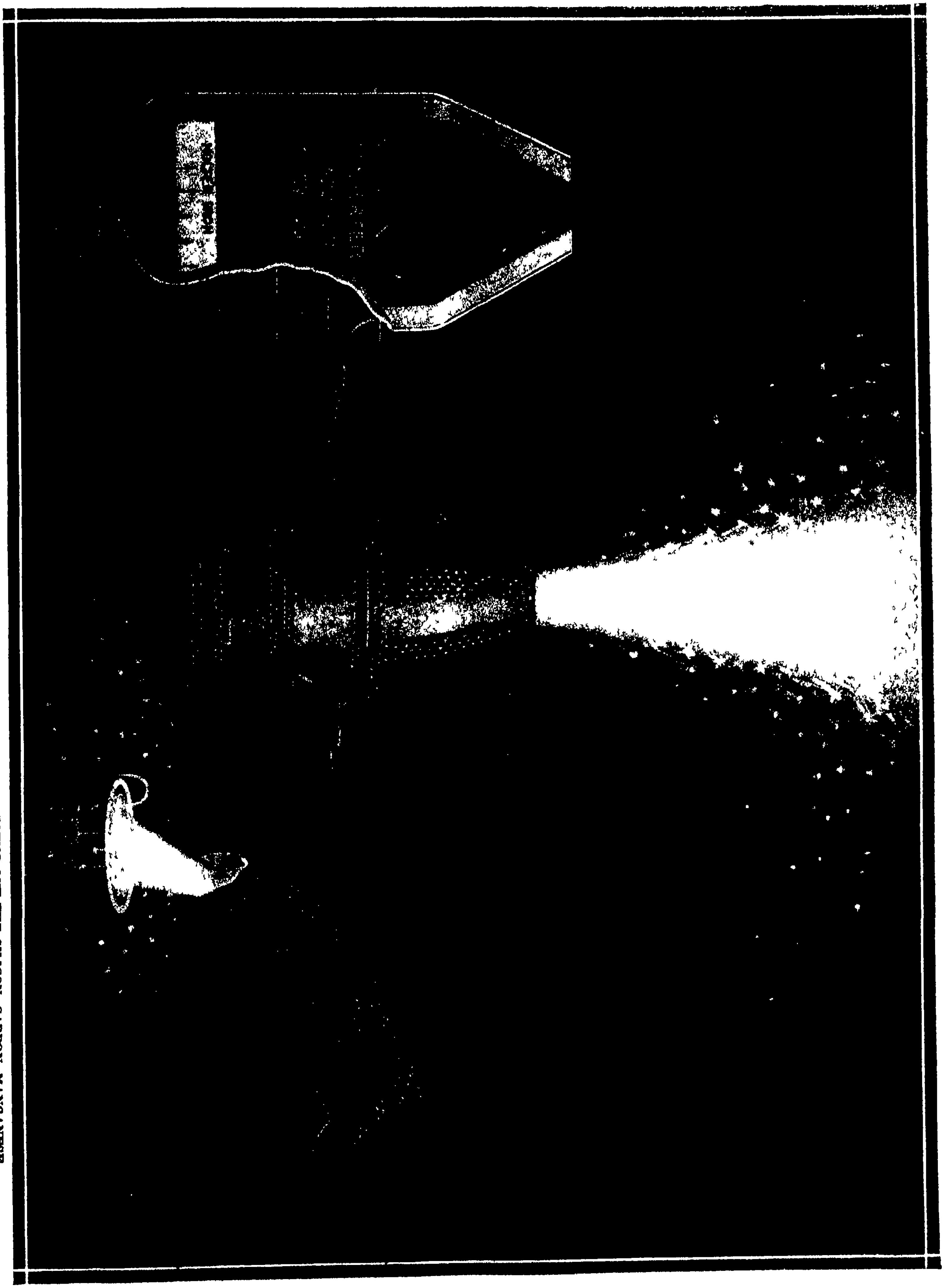


IN THE BESSEMER CONVERTER STREAMS OF AIR ARE BLOWN THROUGH THE MOLTEN IRON, BURNING OUT THE SILICON, CARBON, MANGANESE, ETC.—THE MAJOR STEP IN CONVERTING THE IRON INTO STEEL

When, Where, Why?

How Connecticut Gathers the Data of Her Automobile Accidents, and the Use She Makes Thereof

By the SCIENTIFIC AMERICAN *Staff*

OUR consideration of the automobile traffic problem has been centered, to date, upon the question of uniformity of law But this is far from the whole story In the end, the traffic problem is entirely a matter of accident prevention for if there were no accidents we should be unconscious of any problem Now uniform laws would be of great value in preventing accidents, but the accidents that occur are of such various sorts and arise from such various causes, that neither this nor any other single measure, however desirable and important will prevent them all In view of this complexity the first step in accident prevention is to come to a thorough understanding of the ways in which the circumstances under which and the reasons why accidents occur

If we are thus to attempt the collection of data regarding accidents, we must get it, in the first instance from the people to whom the accidents happen In most cases, one or more of the parties to an accident has a motive for the suppression of facts. Hence it is obvious that we can get at the facts only under the authority of the law through agencies established by the law, and with the distinct backing of the law

Reverting for the moment to the uniformity theme, we find that our several state codes show the widest divergence in the extent to which and the way in which they provide for official examination of accidents Of a handful of motor law pamphlets which we select mainly on the ground of the easy accessibility of their contents, those of New Hampshire and Minnesota appear to make no demands upon the parties to an accident Idaho Maryland, South Carolina Nebraska and California require only the giving of any necessary assistance to the other fellow plus the exchange of numbers names addresses, etc Oregon demands that the recipient of such information make a written memorandum of it—a useful idea, Washington is unusually explicit in forbidding either party to move from the spot before establishing his identity

Numerous states go further than this To the requirement of identification Kansas adds the demand that, "in case of death or serious injury,' resulting from the accident report shall be made to the nearest police or peace officer but one wonders where one's responsibility for knowledge that "serious injury' has been inflicted begins and one wonders also how to interpret the provision that the person "causing" the accident do the reporting Utah's law is much clearer, making it obligatory upon *all* the drivers involved to report, in all cases resulting in personal injury *of any sort* New York makes the same demand, in very precise language, of all those involved in an accident that results in personal injury or damage to a vehicle Illinois attempts the same thing But where New York explicitly requires the exchange of identifications in addition to the report Illinois seems to give one the option between telling the other driver and telling the police Massachusetts, Rhode Island and Connecticut have substantially identical laws which carry the examination of accidents by official action to its climax We quote the statute of the Nutmeg State

"The operator, whether resident or non resident, of any motor vehicle involved in an accident resulting in personal injury or damage to property to an apparent extent in excess of ten dollars within twenty four hours thereafter, shall make a written report of the circumstances thereof to the Commissioner of Motor Vehicles and shall supplement such report by a detailed statement, under oath on blanks to be provided by the Commissioner, which shall be as nearly accurate as may be ascertained and shall state the time place and cause of such accident the injuries occasioned thereby and such further facts as the Commissioner may require The Commissioner may make such investigation of such accident as shall seem to him advisable and for such purpose he may require the assistance of the state police The Commissioner shall take such action as may be necessary to enforce a strict compliance with the provisions of this section." This statute would be improved by a specific requirement that each driver establish his identity with the other, and a really skillful punctuator could distribute the commas in such a way as not to value personal injuries at ten dollars, up, but in the large rather than in such detail suggestion for betterment goes by default.

The necessity and the utility of such close official pursuit of those involved in a motor accident will not often be questioned If the practice were attacked, however, no better means of supporting it would be available than a thorough examination of the entire procedure in Connecticut—a survey of just how the Commissioner collects these accident data and of just what he does with the information after he gets it

If you have an accident while driving in Connecticut, the law contemplates that you will so report to the Commissioner, and by return mail you get a blank to fill out If you don't report, the other party to the smash probably will, and then your goose is cooked For it takes two reports to complete the Commissioner's file on an accident, and if the second isn't forthcoming, he goes out and gets it! The police and the casual witnesses afford another means of checking up, and one of the young ladies in the Commissioner's office clips a large number of accidents from the papers of the State, and every once in so often a failure to report is uncovered in this way The probabilities of your getting away without reporting, in the end, are very slight and of course a late report or a reluctant one is a bad one upon which to rest your defense, not to say a word about the fine

When you get your blank, you are confronted with a regular income-tax return proposition Under the head of general information you are asked for the complete address and exact location of the accident. You are asked to choose between ice, wet, good, snow, rough, mud and sand as characterizing the condition of the road surface at the time, between straight, curve, uphill downhill and intersection as describing the shape of the road, and between clear, rain, snow and fog as describing the weather You are asked the date and the hour and you are given the choice between trolley, railroad train, team bicycle, pedestrian, fence, telegraph pole, road obstruction or another automobile as the thing with which you got tangled up.

Next, about your own car Name, age, sex, address, number and date of operator's license, and did you have it with you? If under instruction, give these details about the licensed operator who was with you. How many years have you held Connecticut license? Did you operate car as owner, or as employee or friend of owner? How long have you operated this particular car, and when did you last test its brakes? Were you operating for hire, business, or pleasure? Give registration number, make, type and year of car, with owner's name and address. State condition of brakes and horn, make of lens, and character of lamps (electric, gas or oil) Estimate the extent of damage to the vehicle, and describe said damage.

You are not expected to know quite so much about the other fellow's car Name, sex, license number and address of operator name of owner, make, type and registration number, condition of brakes so far as you know, appraisal and description of the damage to it. Then you are given a place to tell who was hurt, and how, and to estimate and describe property damage other than to the vehicle If a third vehicle was involved, there is space to tell about it, too

Then there is a place to give the name and rank of any police officer present at the scene, to state who was arrested or summoned (the ordinary police jurisdiction over the accident itself is in no way impaired by the Commissioner's investigating powers), and to record the names and addresses of the witnesses. The text of the blank duly impresses upon you the necessity of getting a complete collection of these names.

Finally you are asked to indulge in literary composition to the extent of not more than ten lines, giving the circumstances surrounding the accident—"state when you first realized that an accident would happen and give in detail how it happened and what occurred after it" Six characteristic road lay-outs are printed in outlined diagram—a straight stretch, a curve a square cross roads an oblique one, an offset square one, and a Y fork, and on one of these, or on a fresh one made to order if none of them applies, you are invited to diagram the accident, using conventional symbols for a car or truck, a team, a motor- or foot-bicycle and a pedestrian, and indicating direction of travel Then you sign, swear, and mail it to Hartford

Now it is obvious that, from the viewpoint of fixing civil and criminal liability for this particular accident, there is a big advantage in thus getting a statement of facts upon official record But from the viewpoint of the Commissioner's office, such advantages, large as they are, are quite secondary The thing that makes this reporting of accidents valuable is the complete statistical record which it affords of the accidents that disfigure Connecticut's highways in the course of the month or the year This record turns in several directions, and we must follow it a short distance in each of these directions if we are to understand the value of the reporting system in *preventing* accidents.

For one thing, you will recall that the parties to an accident must report the years in which their machines were manufactured As a result of this, Commissioner Stoeckel is able to state categorically that old automobiles are more frequently involved in accidents than new ones, and the older, the more frequently This at once suggests that the new driver is not responsible for so large a proportion of our automobile woes as we have ordinarily supposed, and that we may go too far in harassing him in his efforts to learn. More important than that, it suggests to Commissioner Stoeckel that he will ultimately have to ask authority from his legislature to inspect cars, and to rule off the roads those which are in such condition as to jeopardize other

(Continued on page 380)

The numbers that represent the accidents occurring at each point are on pins those up to five having triangular heads and those beyond square heads plain round heads show independently, fatal accidents. Similar maps are kept for all the large cities of the State

A year's (1923) traffic accidents in New Haven, as tabbed in the office of the Commissioner of Motor Vehicles for the State

Our Abrams Investigation—VIII

The Report of a Test on Localization of Abscessed Teeth Through Handwriting

By Austin C. Lescarboura

Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

DOES a drop of blood give off emanations by which it is possible to diagnose the donor's state of health? Can the same thing be done with a specimen of handwriting? Is it possible to carry out the most accurate kind of diagnostic work with a collection of pseudo-electrical apparatus of the crudest kind together with a blood specimen and a human detector or reagent? Is it true that numerous cases given up as hopeless by orthodox physicians have been cured with a machine known as the oscilloclast, which is claimed to give off some form of energy that cannot be detected by normal physical or electrical means? These are some phases of the Electronic Reactions of Abrams technique which the SCIENTIFIC AMERICAN *set out to investigate. Reports on the progress of this investigation have appeared in every issue of this journal beginning with the October, 1923 issue. The reader is referred to the back numbers in order that the present report can be clearly understood.* —THE EDITOR

ONE of the numerous startling claims made for the so-called electronic technique is the ability to localize diseased conditions. That is to say, given a drop of blood or even a specimen of handwriting, the skilled electronic diagnostician should be able to tell not only the cause of the patient's run-down condition, but also the point in his anatomy that is *affected*. Thus it is by no means uncommon for an electronic diagnosis to include some statement as to the localization of a pathological condition; there may be a specific reference to a certain abscessed tooth, an infected tonsil, a certain cancerous growth, a spotted lung, *a marked syphilitic outbreak at a* definite spot on the skin, and so on. Many are the stories told of wonderful localization of various diseases by means of blood and handwriting specimens, and if anything E. R. A. places more reliance on its ability to localize than it does in the high accuracy claimed for its general diagnosis.

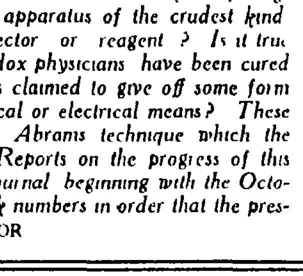
Radiograph of infected teeth of our case B, after extraction of a tooth

Here again it becomes necessary for the Scientific American Abrams Investigation Committee to seek first-hand proof as the result of tests. Were we to take the testimonials of E. R. A. at *their face value, we should be obliged to admit the* condemnatory statements of those who have already investigated certain phases of electronic work. Obviously, it would not be fair nor scientifically correct to admit one side of the evidence without admitting the other. Time and again we have been asked by E. R. A. to accept their evidence at its face value, and time and again we have offered to publish their side of the story on the condition that each and every bit of their evidence be subjected to proper examination, and that we be permitted to publish evidence supplied by parties who have investigated and who are now quite obviously antagonistic to the progress of E. R. A. And so we arrive once more at the conclusion that the best evidence is that which this impartial committee can gather through its own efforts and over which it has absolute scientific control so as to have its findings based on cold *facts rather than mere hearsay and* highly colored claims.

So in the matter of localization we have sought a test with a competent electronic worker, an E. R. A. worker if possible, but at any rate a competent "electronist." By now it should be clear to those who *have followed the progress of this investigation that* while there are genuine E. R. A. workers and non-E. R. A. workers, the technique is uniformly based on the same broad principles enunciated by the late Dr. Albert Abrams of San Francisco, the founder of the Electronic Reactions of Abrams school of medicine, known as E. R. A. for the sake of brevity. Whatever may be the impelling motive, the fact remains that many of those who have taken the authorized E. R. A. course of instruction and who have started out with authorized E. R. A. equipment, have in short order gone about devising their own variation of the so-called electronic diagnosing and treating equipment. Always, of course, the claim is made that because of the desire to place electronic technique on a more *scientific* and stable basis, this particular doctor to whom you happen to be speaking has spent vast sums of money and vast funds of brain power to the end of evolving this particular kind of apparatus. Of course Abrams is given full credit for the basic discoveries—the radioactive properties of blood, the human reactions in the abdomen, which are detected by percussing, *feeling, or rubbing* the abdomen with a glass or vulcanite rod, the different disease wave-lengths or rates, starting with the famous "57" of pickle fame, the treatment of electronic disease findings by means of similar waves or rates, working on the homeopathic theory that like cures like. Always—always please remember in the future—Abrams is the foundation on which the electronic equipment is based. BUT—Abrams, we are assured, was crude. He lacked scientific training. True, he was a great doctor, but when he made these startling scientific discoveries he did not have the necessary scientific training to work them out to the necessary polished state of the present products which you are now beholding. These products are scientifically correct, they work with the utmost precision, they are a vast improvement over the crude Abrams apparatus, so we are told.

There are today some fifty brands of electronic equipment aside from the simon-pure Abrams apparatus. The genuine E. R. A. men using genuine E. R. A. equipment will tell you that *all other brands of equipment are to be* taken with a grain of salt. The genuine apparatus of Abrams has many secrets locked up in its admittedly crude cases and therefore works where others fail. Any test which this Committee undertakes with a non-E. R. A. man using *non-E. R. A. apparatus* is immediately repudiated by the dyed-in-the-wool E. R. A. men. Take the other side of the picture: the non-E. R. A. men using non-E. R. A. equipment will tell you that the genuine E. R. A. workers are relatively crude and are working with hopelessly *inaccurate apparatus. Therefore, any test made with* a genuine E. R. A. worker using genuine E. R. A. equipment is immediately repudiated by the non-E. R. A. group. And to make the matter still more humorous—if there can be any humor in this huge movement which has enrolled upwards of four thousand doctors throughout the country—any E. R. A. worker who submits to an official test is immediately disowned on the various grounds that he is incompetent, that he is not using the very latest technique, that his equipment is of an ancient vintage famed for its inaccuracy, and so on. And so it goes.

An investigator soon begins to wonder whether it is possible to get together a genuine E. R. A. worker equipped with a genuine, accurately calibrated E. R. A. outfit, working with a genuine subject or reagent, provided with specimens of blood or handwriting which have not been tainted somehow, and with generally favorable conditions such as a non-antagonistic frame of mind on the *part of the investigators so as not to* upset the delicate reactions.



Radiograph of infected teeth of our case A

However, all that may be, the fact remains that the technique is always the same. The basic principles are the same. The reactions on which the entire electronic structure rests are the same. Quoting from a letter from Dr. Jean du Plessis, head of the Chicago College of Electronic Medicine and one of the leading E. R. A. workers: "You are of course aware of the fact that the type of apparatus makes mighty little difference in proving the existence of the essential phenomenon. So, here we can put down on record once and for all *that no matter what particular brand of apparatus is* employed in any of our tests now or in the future, the *essential phenomenon* is nevertheless under test just as much as if we were working with a genuine E. R. A. outfit."

It appears that the non-E. R. A. group have been taking keen delight in the fact that so far we have received no tangible co-operation from the genuine E. R. A. camp. Indeed the non-E. R. A. group of late *have put forth the claim that the reason why no con*clusive E. R. A. demonstrations were forthcoming was because the E. R. A. apparatus was defective. In fairness to E. R. A. let it be said here that every demonstration we have witnessed with the use of non-E. R. A. apparatus, no matter how elaborate that apparatus may be, has failed to prove the validity of the basic claims. *All the electronic* workers *are pretty much* in the same boat so far as their ability to prove anything is concerned—at least up till this writing.

All of which is rather off the main track of this particular report on the progress of our Abrams investigation. However, it is quite necessary to settle at this time this question of genuine and independent electronic workers and their apparatus.

Some time ago a well-known gentleman in Los Angeles who has taken a keen interest in the Abrams controversy suggested that we make a test with a doctor connected with a Pacific Coast electronic laboratory for the purpose of testing the remarkable accuracy of electronic localization. Through this gentleman's kind offices we *submitted two specimens of handwriting* as directed, these specimens representing two dental cases with clearly defined abscessed teeth. The electronic worker was to identify the abscessed teeth by means of the handwriting specimens. And so we have the electronist's report of his findings as well as the report of the dentist, Dr. Mitchell of the Bronx, who co-operated *with us in the selection and prepara*tion of the cases for the electronic examination.

The first patient was our case A. He came to the dentist's office with a badly infected tooth. Orthodox dental examination disclosed an in*fection around the upper right second* bicuspid. It may be mentioned here that this tooth is the one immediately ahead of the upper right 6th year molar. Reference to the accompanying radiograph will clearly indicate the infected area within the circle. The light area within the arrow head tooled in on the engraving for reference purposes shows the diseased root of the tooth.

The second patient was our case B, who also reported to the dental office with a badly swollen face due to an infected tooth. *Orthodox dental examination disclosed* infections in the right central and upper left lateral teeth, the infection of the latter being deep-seated and necessitating considerable treatment and drainage. The circle in the radiogram of this patient shows the infected area after the extraction of the upper left lateral tooth.

Hence in both these cases we had clearly defined abscessed conditions, which were sufficiently developed to make them identifiable beyond the shadow of a doubt by any means which lay claim to even a modest degree of accuracy. We were assured beforehand that the electronic worker in this case, as well as his electronic laboratory, scored very high in this kind of work; hence we looked forward to a clean-cut success in both these cases if electronic localization was to be taken seriously.

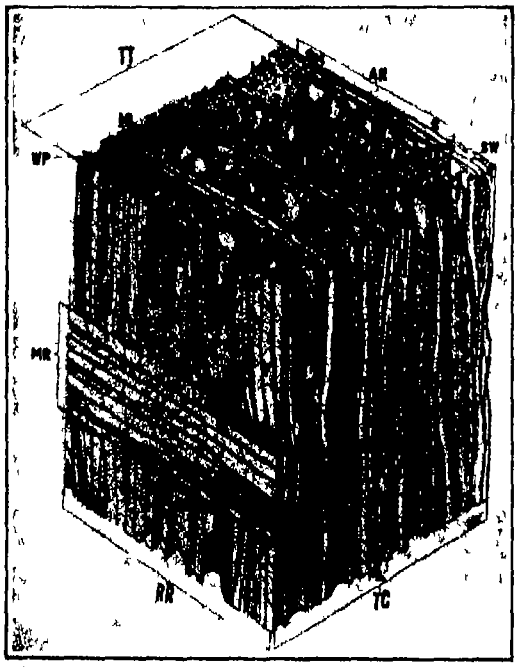
In due course we received a letter from the Los Angeles gentleman stating in part: "I am herewith enclosing memorandum of the two teeth which Dr. —— thinks he has located as being abscessed according to the handwriting you have sent on to me. Dr. —— made this diagnosis with a machine constructed especially for himself and he

(Continued on page 361)

Does Paint Preserve Wood?

A Conflict Between Theory and Practice, and How It Is Explained Away

By H. D. Tiemann
Dry Kiln Expert, U. S. Forest Products Laboratory, Madison, Wis.



TT, section across the grain; RR, radial surface (quarter sawed or edge-grain); TC, surface tangential or parallel to the annual rings (flat-grain); MR, medullary rays; V, vessels; F, wood fibers; S, SM, springwood and summerwood portions of the ring; P, pits; SC, gratings at longitudinal junctions of vessels

Fig. 1. Highly magnified view of a block of hardwood, showing its cellular structure, from a drawing by the author based upon actual micro-sections

DOES painting actually preserve wood? And if so, how? The question is not so simple as it seems. Ask the timber pathologist, and the answer is that there is nothing in ordinary paint which is poisonous to fungi and therefore it does not prevent decay by any antiseptic action. So far as known, decay occurs and can only occur through the action of fungi. He will say furthermore that paint may even induce rapid decay by keeping the wood damp on the inside, retarding its rapid drying when placed in a situation where it frequently is subject to wetting—in other words, introducing a factor of lag in the wet-dry cycle.

The wood technologist moreover will tell you that paint does not prevent the absorption of moisture from the air. While undoubtedly a retardant, it does not act as a moisture-proof seal, and nothing but hermetically sealing up the wood will prevent its ultimately absorbing moisture if exposed to a damp condition long enough. Some forms of varnish are better in this respect, shellac is good, and paraffin is better still. Three coats of spar varnish may postpone the final action for a month or two, but linseed oil paint, even in heavy coatings, will only delay the evil a few weeks. Consequently the "working" of wood — its shrinkage and swelling with exposure to dry and to damp air for considerable lengths of time — cannot be prevented by painting or varnishing. This phenomenon is only too familiar to every householder as well as woodworker through the shrinkage and swelling of floors, doors, picture frames and furniture. In heated rooms in winter the moisture content will drop to four or five per cent of the dry weight and in summer, with outdoor conditions in the house, it will rise to 12 or 14 per cent or may even reach 18 or 20, with attendant sticking of drawers and rubbing of doors.

Now suppose you go to the builder or the practical man in general and ask him about this matter of paint. His verdict, based on years of experience, will of course be that painting is highly beneficial in protecting the wood.

Are the technical men wrong? Or can we somehow reconcile these apparently conflicting ideas?

The answer lies in the behavior of wood to the influence of moisture, a manner of behavior which is not generally understood. All the statements made are true and it is interesting to follow out the way in which paint actually does prevent or retard the destruction of wood. We need not appreciate paint less for knowing wood better.

Some of the phenomena which take place when wood dries will need explanation. Perhaps the most important of these is the peculiar propensity of wood to become "set" or fixed in the position and dimensions in which it is held while it dries. While wet, and particularly when warm, it is somewhat plastic and may be distorted to a certain extent by applied forces. If the forces are applied continuously during the drying, the wood will harden and retain the distortion even after the forces are removed.

This statement applies not only to the piece as a whole but also and more especially to the internal structure. Suppose a piece of wood which has been thoroughly moistened is prevented by framing or bracing from shrinking until it is dry. It will become set in its expanded condition and will remain enlarged after the bracing has been removed. The internal stresses set up at the start seem to have disappeared entirely. But they have only become latent, as it were, and if the wood is remoistened they will again reappear in full force and effect. For example, if a piece of bentwood be remoistened it will tend to straighten out, particularly if heated. The hardening process is thus quite a different thing from the hardening of cement where the stresses do not thus become latent, and it should not be thought of in the same way.

The actual internal mechanism of wood behavior under moisture changes is unknown, but in order to picture what will occur in wood under given circumstances the following analogy may help. Imagine a honeycomb in which the cell walls are composed of a substance which is plastic and somewhat elastic like rubber when wet but loses these properties when dry, hardening in whatever shape it is held while drying. Furthermore, suppose that the substance itself swells and shrinks with moisture changes. Suppose we take a wet block of this honeycomb and compress it by an external applied force. The result will be that the cells will become distorted instead of being hexagonal; they will become more elliptical in outline. Now let the substance be dried while being held in this distorted condition. The walls will at first stiffen up and lose their elasticity so that there is no longer any tendency for the cells to resume their hexagonal form, the stresses thus disappearing or becoming latent. This is an explanation, or a fairly good picture at least, of the "setting" of wood in a distorted shape or size when it dries.

Fig. 2. Section of a two inch walnut plank cut into prongs to show the stresses which occur internally during drying

At this stage a further important effect of drying will occur; the same process will be noted when we come to the actual phenomena of wood. The wall substance itself, according to our hypothesis, will begin to shrink and the result will be that the block as a whole will finally reach a *smaller* size than it would have done had no compression been applied to start with. (A similar result of the opposite kind may be produced by stretching the block originally.)

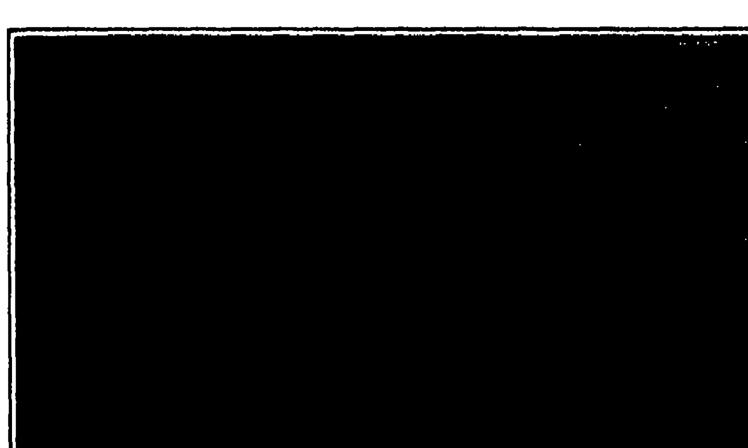
Now, to come closer to the main point, let us suppose that we start with a dry block of this honeycomb and clamp it in such a way that it is impossible for it to swell (just like honeycomb in its square wooden frame), but that we exert no external compressive force upon it other than the resistance to its own swelling. Now let it be moistened, and what will happen? The cell walls will swell but as the block as a whole cannot expand, the walls of the cells will crumple, distorting the form of the cavities. If now the substance be dried it will harden in the new crumpled shape, the stresses becoming latent exactly as in the other case. The cell wall substance will then shrink as before and the whole block will pull away from the box, and it will now occupy a smaller space than it did originally before it was moistened. Upon remoistening in a free condition the crumpled walls will resume their elasticity and tend to return to their original shapes. Fig. 1, which is a drawing of a grain of hardwood sawdust highly magnified, shows that our honeycomb analogy for wood structure is not so very far from actuality.

Coming now to the actual drying of a piece of wood, the sequence is this:

The outer surface, drying first, tends to shrink but is prevented from doing so by the moist interior. Stress is set up, the outside in tension, the inside in compression. The outside then becomes set ("casehardened") in its expanded condition, as explained in the analogy. As soon as the free water has all evaporated from the cavities of the interior cells ("fiber saturation point" passed), the inside of the block tends to shrink but is in turn hindered from doing so by the expanded set exterior. The stresses are therefore reversed, the inside now being in tension. As drying proceeds still further the inside becomes "set" in an expanded condition which, owing to a slight yielding of the exterior, will be of a less degree than the set of the latter, or else the tension will become so great that the fibers will actually pull apart causing what is commonly designated as "honeycombing" or "hollow horning."

These stresses are easily proved by cutting a cross-section from a dried block and slicing it into prongs like a fork. The unbalanced stresses cause the prongs to curve, the tension side being concave and the compression convex.

By an indirect method the set condition is also easy to show. If the section be sliced into prongs when only half dry and then allowed to dry slowly in the air, the outer prongs will shrink much less than the

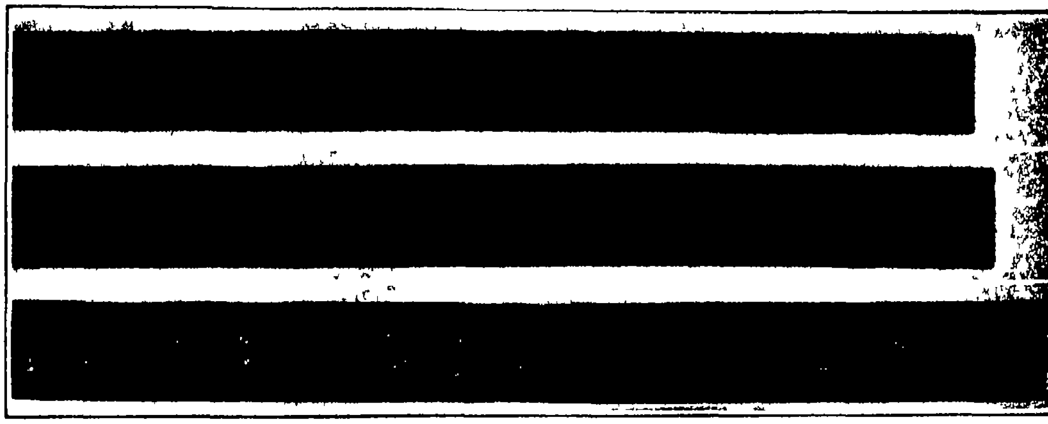


C, piece in original air-dry condition. A and B, steamed and redried. A, prevented from swelling by a clamp. B, free. Note the end checks on B due to the restriction on swelling imposed by the rest of the board

Fig. 3. Oak board showing the result of prevented swelling when moistened

inner ones, owing to their already set condition This is clearly shown in Fig 2, which is a section of a walnut plank treated in the manner just described The internal stress which would have existed had drying been completed before the slices were made is approximately measured by the force which would be required to bring all the prongs to the same length This is evidently considerable Can you wonder at a piece of lumber for cracking open or warping under such stresses? Yet this condition is not the exception but the general rule In fact it is practically impossible to dry a piece of wood without such stresses occurring to a greater or less degree If there is doubt about this in the mind of anyone let him make the test himself *It is very easy The section should be cut while the* board is still damp inside as explained above

We are now able to predict what is likely to happen to a piece of wood exposed to the weather If a dry piece of wood is held or clamped in such a way that it cannot swell and it is then moistened a strong *compression stress will be set up by the wood itself in* itself which will act in the same manner as an applied external force If the wood is redried under this restriction it will become "set in compression" to such an extent that when it finally reaches its original state of dryness it will be *smaller than it was before* By repeating this process a piece of wood may be made smaller and smaller By the method of repeated wetting under restriction and then redrying a strip of air dry basswood 9 15/16 inches long tangentially to the rings was compressed to a length of 7 7/16 inches.



A normal *B* and *C* soaked and redried *C* having been clamped while drying and *B* free All three thoroughly dried

Fig 4 Experiment showing how wood may become set in expanding condition

Fig 3 shows a one inch oak board from which the smaller end section was first cut off and the larger piece cut in two One half of the larger piece (marked *A*) was then clamped in an iron frame so that it could not expand tangentially was steamed about a day, and was subsequently allowed to dry again It soon became loose from the clamps and finally shrank to the size shown in the photograph The other half *B*, received precisely the same treatment as *A* except that it was not held in the clamp while being steamed and was *free to swell* as much as it pleased Notice also that the ends of the piece which was not clamped are very much checked This is not an accident but is due to the same cause Since the wood takes on moisture much more rapidly at the ends than in the middle the ends tend to swell they are prevented from so doing however by the middle portion of the block The ends are therefore thrown into strong compressive stress, just as the clamped block was and when the block is dried they will in the characteristic manner shrink more than the rest of the block, thus opening up in wide end-checks

This is not merely an interesting laboratory experiment of purely scientific interest not by any means It is one of the most fundamental facts concerning the behavior of wood and applies all the way from the lumberman's shanty to the finest piece of furniture in the lumber king's palace, but it is not commonly understood.

The reverse of this action may also be brought about as in the casehardening of the outer surface of wood illustrated in Fig 2 In Fig 4 are shown three strips of basswood all cut adjacently from an air dry flat-grain board The length of the strip is tangential to the rings *A*, which is ten inches long, was retained in its air-dry state *B* and *C* were soaked in hot water, *C being then clamped* between two strips of perforated iron All three were then thoroughly dried at 200 degrees Fahrenheit The piece *C* held in the clamp during drying could not shrink appreciably and became "set" in this expanded condition in which it now remains indefinitely after removal of the clamp and will so remain until it is soaked again

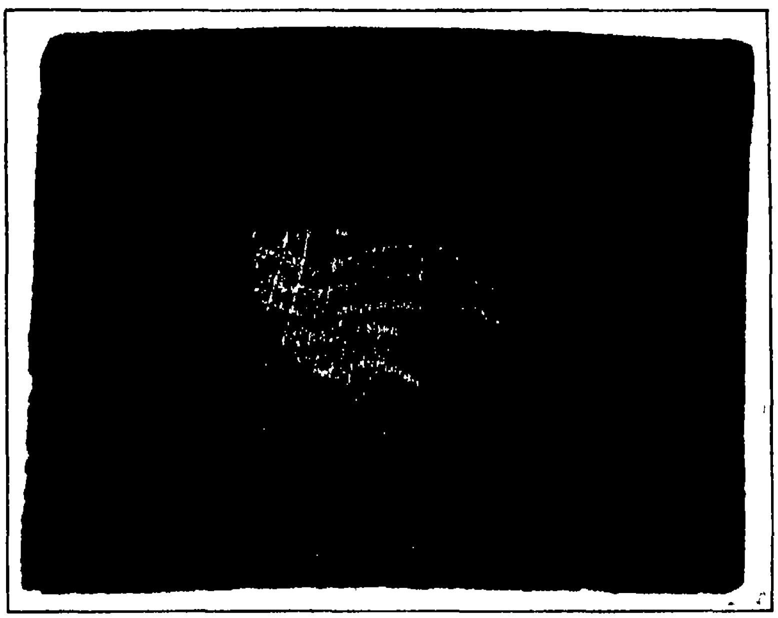


Fig 5 Section of oak, showing compression checks produced by wetting and redrying a small portion

But what has all this to do with paint? Let us see

In Fig 5 is shown the cross section of a well dried piece of red oak which showed no checks The central area was then wet several times with hot water care being taken not to wet the surrounding portion Upon redrying, the cracks appeared as seen in the photograph Now these cracks were not produced by the wetting and drying alone but *by the compression stress caused by the restriction to swelling the subsequent setting of the substance under compression and further shrinkage as it redried* Repeated wetting and drying causes an accentuation of this condition It is this identical process which causes exposed surfaces of wood everywhere to crack open and become weathered One frequently observes its results in hardwood window and door sills flooring and steps which are subjected to repeated wetting and drying As dirt enters the cracks the compression is thereby increased each time the surface swells, when it dries the openings become wider and the cracks strike in deeper and deeper It will be observed that at first it is only a *surface effect* and is due to the prevention of the swelling of the surface by the deeper portion of the wood which has not yet become wet It is the abrupt changes in moisture content between the surface and the inner layers of the wood, or between any adjacent portions, which are responsible for the conditions of surface checking and subsequent deterioration

Paint is not proof against gradual absorption of moisture and therefore will not prevent swelling or shrinkage from taking place if given sufficient time What it does do is to *retard the rate of absorption or loss of moisture through the surface* thus giving time for a partial equalization of the moisture and reduction of the moisture gradient within the piece Paint does not make wood poisonous to wood destroying fungi but by preventing the surface cracks it makes it harder for the fungi to get a foothold and so helps to preserve the wood

The equalization of the moisture distribution throughout the piece brought about by the coating of paint when applied to all surfaces also prevents excessive warping of the piece as a whole

Fig 6 shows an oak board which has become considerably cracked in the central portion This board, a flushtank cover was subject to repeated wettings and dryings The surrounding portion which is not cracked was protected by a coating of paint and oil whereas the coating had entirely worn off the central portion The explanation has been suggested, and the result speaks for itself

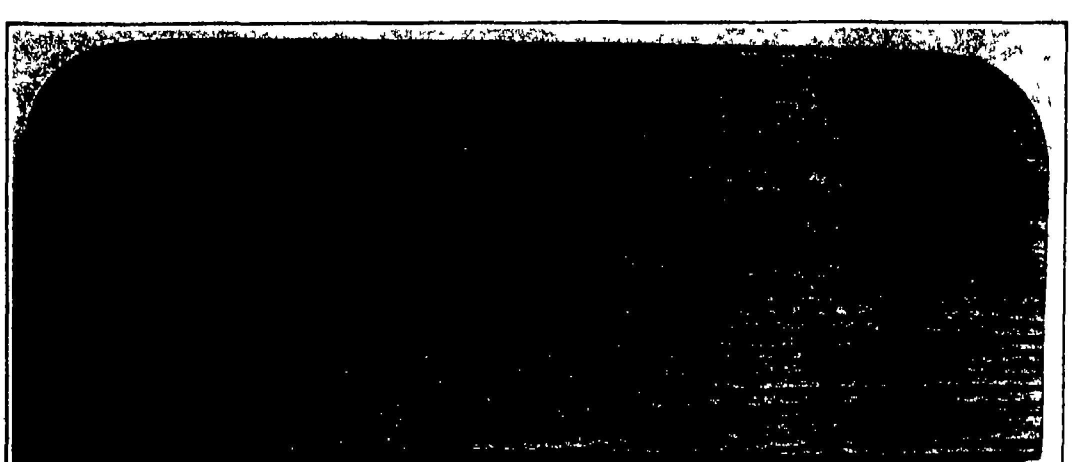


Fig. 6. The checked portion here was unpainted, and subjected to repeated wetting and drying

A New Trade, the Straightener?

A CONTEMPORARY suggests that there is one line of repair work that is practically untouched so far as specialization is concerned yet is peculiarly adapted to segregation and placing in a one- or two-man shop There is a never ending volume of straightening to be done and it can be made to pay much better than ordinary repairs The straightening shop is badly needed in the automobile repair business and the machinist of ability in that line will be received with open arms The wear and tear of every day running the uncorrected loosenesses, clean breaks little accidents of driving and all the happenings included under the name of "wrecks" serve to feed the job list of the straightening shop An expenditure for equipment that would put in only the gas tank and pump of a garage or would but poorly equip another specialty shop, will fit up the place in first class shape for straightening work of every conceivable description

Exploring Within the Steel

How Magnetic Analysis Indicates the Presence of Flaws in Rails and Beams and Hoisting Cables

By A. G. Ingalls

LET us imagine that there is a hidden transverse fissure in the center of a steel rail but you do not know it is there. That rail will later be laid down as a part of a railway track and some cold night when the steel is chilled to increased brittleness, there will be a complete fracture followed perhaps by a disastrous wreck.

That thing has happened many times because there has until recently been no sure way to discover the presence of the hidden defects in the interior of a piece of steel. The same is true of all kinds of flaws not only transverse fissures but slag inclusions and hard or soft spots. But a method for finding such imperfections has been discovered and recently put to work and that method happily permits the entire output of a steel mill or factory to be investigated just as rapidly as it is produced.

Magnetic analysis is in general just what the name suggests. It takes advantage of the various magnetic properties of steel and iron and it permits of the making of many more deductions regarding the inside of a given piece of magnetizable metal than would at first glance seem apparent. So successfully have these deductions tallied up with the facts that the new method of testing steel has been put on a working commercial basis.

To give a brief peep into the nature of magnetic analysis before turning to the considerations which naturally lead up to the exposition of its methods in detail Dr. C. W. Burrows, the pioneer in the field of magnetic analysis research and inventor of the equipment that is being used for the analysis, has said, There is one and only one, set of mechanical characteristics corresponding to a given set of magnetic characteristics and conversely there is one and only one set of magnetic characteristics corresponding to a given set of mechanical characteristics.

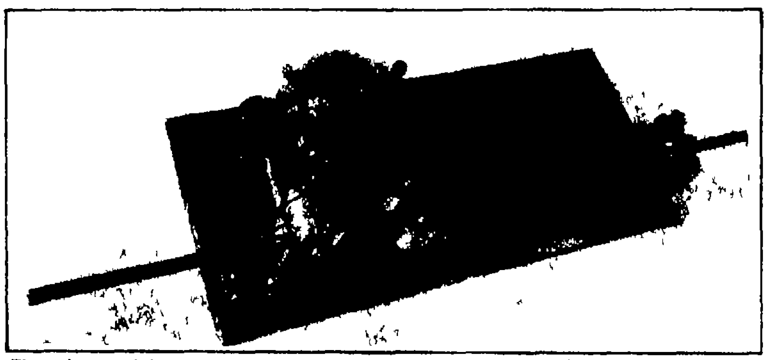
Add to this statement the fact that magnetic analysis makes use of all the several magnetic qualities of steel and iron particularly of induction coercive force residual induction hysteresis energy and the various permeabilities as well as certain combinations of these qualities and that it employs two types or phases of magnetic apparatus known respectively as the defectoscope and the magnetoscope and you have a rough general statement of the question that nearly everyone asks when first confronted with something new. That is: How does it work and why?

Before taking up in detail how it works and why two significant considerations must be gone into. If we are to get a background for an understanding of magnetic analysis as it has been commercialized today we must know a little about who began it and who has been behind its development. Such knowledge gives a sense of proportion to those who have not found it possible to keep in intimate contact with the salient developments of the steel industry. We must also try to grasp the great importance of the testing of the materials of construction and briefly review the tests that have been used by industry in an effort to know the nature of the steel and iron used.

The progress of magnetic testing of steel has been carried on by the aid and encouragement of great railways and great manufacturing industries. Much of the fundamental work was accomplished in the United States Bureau of Standards at Washington. Numerous university professors of physics and engineering have also collaborated in its investigation.

In 1906 Dr. C. W. Burrows, who was in charge of the Magnetic Section of the Bureau of Standards began an investigation of the general problem of the relation between the magnetic and the mechanical properties of steel.

During that year Dr. Burrows was carrying on an important magnetic research in cooperation with several foreign magnetic specialists of note. The investigation required two short steel bars of identical magnetic properties. This seemed to be a simple requirement but it soon became evident that two bars one-half inch in diameter and ten inches long having identical magnetic properties do not exist. They cannot be made. Many thousands of dollars was spent on a fruitless search while specialists and steel experts were unable to give any help. Then special furnaces for the preparation of the desired pieces of steel were prepared while the rolling and annealing were given a care that would make a royal babe seem neglected. And still the resulting bars, prepared as carefully as modern science could prepare them, showed magnetic differences.



The rod is carried through the solenoid by means of two rolls driven by a small motor. The control box galvanometer and recording device are not shown

A laboratory form of rod defectoscope

This extreme sensitivity of the magnetic test of bars having identical properties when measured by other methods of testing, whether chemical or physical seemed highly worthy of further investigation and the knowledge gained from the subsequent research has turned out to be of vastly greater value than would have been a successful conclusion of the original piece of research.

Four years later the Pennsylvania Railroad began an independent investigation of magnetic analysis which was combined one year later with that of the Bureau of Standards. This joint investigation continued at Washington for six years during which period the value of the new method of analysis as an aid to technical research was clearly demonstrated.

In 1918 the American Society for Testing Materials, of Philadelphia appointed a committee on magnetic analysis consisting of research engineers from the tool, ball bearing and rifle industries together with a representative of the New York Central Railroad, and several professors of physics and engineering all cooperating under the Chairmanship of Dr. C. W. Burrows. In 1919 representatives of the National Research Council and of the War Department as well as of leading universities and several additional industries which had taken up magnetic analysis during the year, were added to the special magnetic analysis committee of the American Society for Testing Materials.

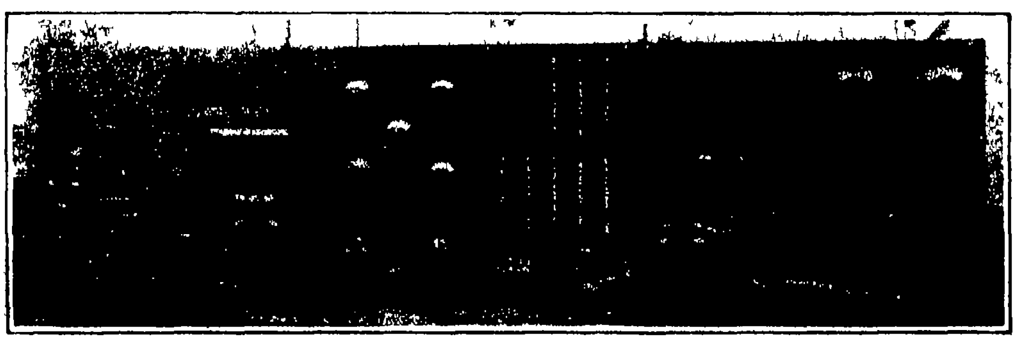
This Philadelphia society is very largely responsible for our present knowledge of the materials of engineering and for the standardization of specifications and method of testing. Formed in 1902 it has a very large membership among the engineering and allied professions and it has kept in existence forty standing committees with a total membership of about 1400 for the purpose of studying the properties of materials of engineering and developing standard specifications, methods of testing definitions and recommended practice. Its activities are intimately woven into our whole industrial fabric. Naturally its work is known to a lesser degree outside of the engineering profession than within it, because it is of such a nature that it does not often penetrate through the fundamental layer of the constructional world formed by that profession. But its work nevertheless stands underneath the whole structure.

The great and fundamental importance of testing the materials of construction cannot be overestimated. Not only money and things, but life depends upon it. Take the case of railway rails. There you have a comparatively concentrated mass of iron and steel the locomotive, weighing up to nearly a million pounds thundering over a pair of steel ribbons that must be free from flaws if they are to withstand the stresses they are subjected to by such great weights in motion.

Our railroads buy two million tons of steel rails every year. The great automotive industry uses another three and one-half million tons. Another five million tons go into buildings bridges and other structural work. All of these things have direct connection with the safety of human lives. This fact furnishes one of the chief reasons why steel must be tested before it is used.

Users of steel usually refuse to buy an ounce of it unless they know its composition accurately. Yet none of that which they buy and use has been tested. Here is a paradox!

When we state that a given lot of steel has been tested and the analysis returned we mean simply that samples of it were tested. One hundred tons of steel is made poured into ingot molds, rolled out and a few pieces chosen at random for tests. Even at best it is a case of testing one piece out of a dozen or a hundred and gambling on the hope that the remainder are like this piece which has been destroyed in the process of testing. This is essentially a hit or miss method but until the development of magnetic analysis it was the best method known.



The instrument board supports a collection of ammeters and voltmeters an A. C. indicator and a heavily damped D'Arsonval galvanometer. Toward the right are four relays for operating the signals used with the defectoscope and A. C. Analyzer. Directly above them are two colored lights that flash momentarily when spots that are harder or softer than the average of the steel pass the solenoid. In the foreground is a special type of magnetic comparator used for testing handsaw blanks for correctness of heat treatment. By testing these blanks before polishing instead of afterwards as had been necessary before the use of magnetic analysis a considerable saving to the manufacturer was effected

A corner of the Burrows magnetic laboratory

Not only is the method of basing the quality of a batch or lot of steel on tests and analysis of mere samples fraught with the ever present danger that luck may play strange tricks with the choice of samples, but it involves the destruction of these samples. In order to test the transverse strength of a structural steel shape you must bend it past the elastic limit and destroy its usefulness. In order to make a chemical analysis of a sample you must ruin it. If you wish to examine it under the microscope you must cut it up into very thin sections. The piece you test is never the same piece you are to use. It is one of a lot, and your faith must make up for the uncertainty involved thereby.

In the early days the judgment of the workman was the chief criterion of steel quality. He looked at

the grain of a freshly broken piece, judging it by a blow of the eye." Then there was the cold bend test in which he bent a piece flat on itself and examined the stretched fibers or he broke a piece of the steel and read his carbon by fracture.

Later tests largely eliminated the human factor. The tensile test is made in a powerful machine which tears the test piece in two, giving a record of its strength. This is necessarily a destructive test. The compression test, where the test piece is crushed, is likewise a destructive test. The bend test is of a similar nature.

One very important test is that for determining the hardness of steel. The scleroscope, which is sometimes used for this purpose, makes use of a little steel hammer having a slightly spherical striking point two hundredths of an inch in diameter. This is dropped a distance of ten inches on the test piece, making an indentation and rebounding to a measurable height. The impact corresponds to a pressure of several hundred thousand pounds per square inch and the hardness of the sample is measured by the amount of rebound. A second test of hardness is called the Rockwell test, while a third method which is very widely used is the Brinell test. Here a hardened steel ball is forced into the metal, making a tiny concavity. The maximum pressure applied divided by the area of the concavity gives an arbitrary Brinell number, or hardness number. This test is non-destructive but it tells nothing further than the surface hardness of the steel. Hidden flaws are not found by it.

Chemical analysis is one of the most important methods used for learning the facts about a batch of steel. A well-equipped chemical laboratory forms a part of all modern steel plants. But it likewise applies *only to samples and it also ranks as a* destructive test. However, chemical analysis will always remain an invaluable aid to the steel maker.

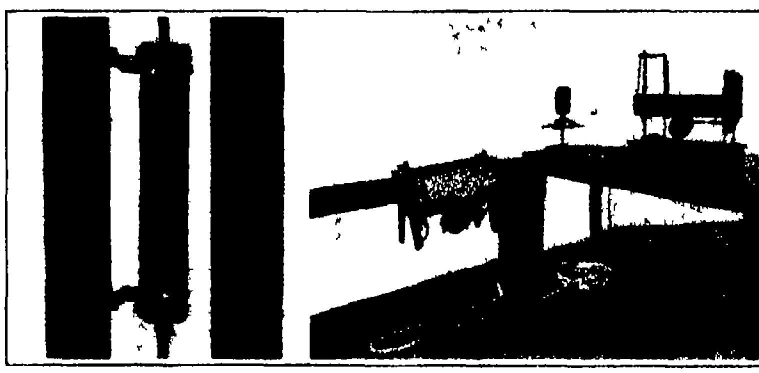
Metallography is a method of examining sections of steel or other metal under the microscope. Sections about one half inch square are ground down to a fine polish and examined microscopically, then they are deeply etched in order to show the crystalline structure. Says Professor Bradley Stoughton of Lehigh University: "In the United States practically every large steel works is well equipped for the microscopic analysis of its product. Although only a little more than 25 years have elapsed since the first art received attention it has advanced so far as to have become by now another and very serviceable tool in the hands of the expert. But," continues Prof. Stoughton, "reputations have more than once suffered severely because of erroneous deductions made from microscopic evidence."

The *examination for homogeneity of* iron and steel by means of the X-rays is becoming common. Yet it is so slow that it can be applied only to thin work or to suspected places. At the Watertown Arsenal a very expensive 300,000 volt X-ray apparatus is able to make clear and distinct photographs through a thickness of one inch of steel in one minute. But a two-inch *thickness requires five minutes* while three inches, the present limit, consumes thirty minutes. Greater thickness than this may be seen through by magnetic analysis almost instantaneously, permitting long heavy products to be moved along at a lively rate of speed while they are examined. The fact that the relatively slow X-ray study of steel has exposed many previously unsuspected defects such as forging and shrinkage cracks, shrinkage cavities or porous spots and burnt metal favors the use of the far faster magnetic analysis for the same purpose.

It must be made clear that magnetic analysis is *not intended as a substitute* for all of the forging methods of testing steel. Rather it complements them by newer methods.

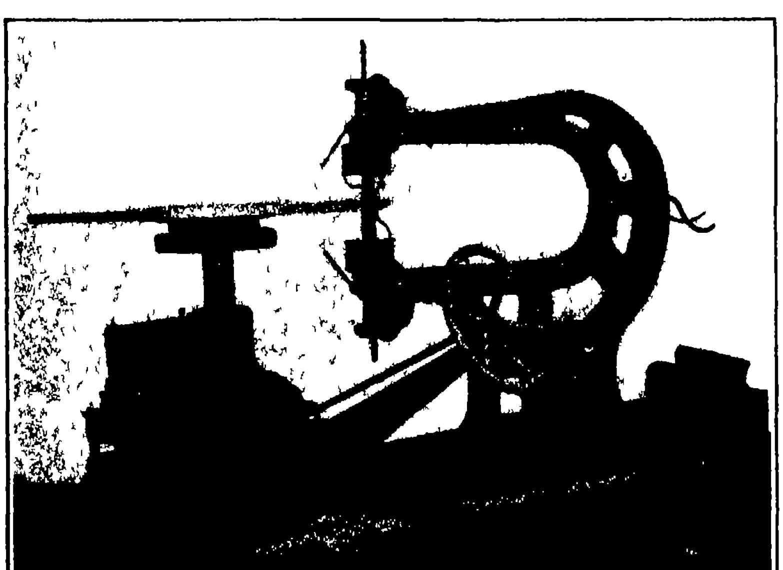
This equipment is designed to test all circular parts such as pinions, races for ball and roller bearings, etc. It determines defects in machine parts, depth of case after carburizing and physical structure after heat treating. The magnetic field is revolved either mechanically or by means of a polyphase current while the average nature of the piece is determined quantitatively

Analyzer for testing round specimens



Left: This form of defectoscope may be kept permanently mounted in shaftways for periodical *tests of stranded cables. The control and recording apparatus are located at a distance. Right:* Instead of moving the rails through the solenoid as is done in commercial installation, the rail here remains stationary while the solenoid is caused to traverse its length by means of a small motor

Solenoid of cable defectoscope in place in elevator shaft, and the laboratory form of defectoscope



Bucket wheels *for steam turbines must be of irreproachable quality and homogeneity.* **In this installation a ten-foot disk is being analysed by the defectoscope in a search for blowholes and weakening inclusions. The disk is slowly revolved while the instrument is steadily moved outward from the center, thus covering the whole area in the form of a spiral**

Magnetic testing apparatus for steam turbine bucket wheels

In addition to telling us things we can already find out by the ones that have been in use, it tells us things we have never been able to know. Because its intangible magnetic fingers search within and throughout a piece of solid metal it is able to locate physical defects that cannot be known in any other practical manner. Better still these all-permeating magnetic feelers leave no harmful trace of themselves. When they have passed and done their work the steel remains as sound as before.

Magnetic analysis permits the large output of the steel mill or of the factory to be passed in rapid review without the aid of technical experts and without slowing up the process. The examination is sandwiched in with *the regular machine-to-machine* progress through a factory in such a manner that the steel has merely to be routed through the magnetic equipment without stopping. If flaws exist in the rails or rods or in any of the long shapes a record is left either by an automatic device which paints the piece opposite the point of defect or by a line which is automatically traced on a slowly moving photographic film. Sometimes a colored light is flashed or a bell is rung to indicate that a defect has been located.

The magnetic properties of a piece of steel are determined by its past history. Every detail of its chemical constitution, its course of manufacture, its heat treatment and the stresses to which it has been subjected have united to determine its magnetic nature. For steel of a given history there is only one set of magnetic characteristics. Taking full advantage of this fact there are two phases of the magnetic analysis: those employing the instruments known respectively as the defectoscope and the magnetoscope.

The defectoscope analyzes long specimens such as rails, pipe, beams, wire, shafting, rods and cables for flaws such as concealed fissures, blowholes, segregations, local hard spots and inhomogeneities. It determines whether nonuniformities exist but does not indicate whether the specimen as a whole is hard or soft. It employs direct current. The application of this instrument has been developed quite fully.

The other instrument which is employed in magnetic analysis and which is called the magnetoscope analyzes irregular shapes and small parts as forgings, castings, crankshafts, tools and various parts for automobiles and general machinery. Unlike the defectoscope it is essentially a comparator, in that it requires a standard piece against which it checks the piece under test. It compares its general physical properties such as hardness, grain size, and chemical composition with those of the standard piece. The magnetoscope uses alternating current unlike the defectoscope which uses direct, and the phenomena employed in making the analysis may be either hysteresis energy or magnetic hysteresis.

Returning to the defectoscope, this instrument consists of a magnetizing solenoid and a system of two exploring coils having the same number of turns. These coils are bucked, that is the turns run in opposite directions. The solenoid is energized by direct current and the piece to be tested is passed through its interior magnetic field as well as through the two exploring coils which are separated from each other some inches. Any inhomogeneities in the moving steel will cause magnetic leakage as they pass. That is the density of the lines of magnetic force set up in the metal will be altered. The changing magnetic flux reacts on the two exploring coils generating a current in them which is stronger in one than in the other and making *itself evident on a sensitive galvanometer.*

When using the defectoscope there is in general no indication of the physical condition of the piece as to hardness, grain size and analysis so long as these properties do not vary too sharply from point to point along the piece under test. So long as it is uniform no indication is given—the spot of light thrown by the galvanometer mirror remains fixed or if a photo-

(Continued on page 366)

The Grocery on Wheels

A Self-Service, Motorized Store that Effects Great Economies for Dealer and Customer

The plate-glass show-window in the rear of the motorized grocery

IT'S A big job that the ladies have to do every day There is being spent today and every day in the United States $40 000 000 for food stuffs by your wife and mine and the 35,000,000 other women who provide home meals for the tired business men- meaning you and me You could run a mighty big war on that money For each one of the 105 million of us these shoppers spend 45 cents today and every day If she does her shopping by phone milady must add 5 per cent to every dollar of your money she spends Then when the store delivers the order that adds another 10 to 15 per cent to the price—for the dealer must charge for this service or lose money on your business

On the other hand if the housewife goes to the non delivery or chain store she saves the phone and delivery items, but spends an hour or more, depending on the distance which she must go to get the groceries and meats Even though her time has never been valued in dollars and cents—it is nevertheless an expense and often an inconvenience to her to spend an hour a day "at the store "

Let us look at the marketing situation from another standpoint It has been carefully estimated that fifteen cents out of every dollar of yours spent for food stuffs must go towards running expenses of the store—in other words into overhead This is not for wages to the producer a wholesaler's profit nor transportation—but just for rent, heat light, clerk hire hand bills advertising and other necessary expenses These items which you pay for when you buy groceries or meats at the store consume one-seventh or a little more of your monthly food bill These are facts taken from proven statistics they should be of vital interest to every man and woman

In a typical neighborhood there are five grocery stores—three of them are chain stores Each one of these stores draws trade from a radius of three to five blocks The average chain stores sales in large cities are $475 per week and the average net profit is between 2 and 3 per cent—and that 2 per cent plus is hard to get It requires scientific management to do it More than this, few stores turn their stock more than thirteen times per year and they have to turn it 8½ times per year to keep out of the bankruptcy courts You will wonder that any of them can make money when we tell you that there are 457 000 grocers and butchers for the 24 000 000 families in the country—or one tradesman for every 54 families

Is it anything to be surprised over then that only five grocers out of every hundred succeed in business? Fifteen out of every hundred stagger along the financial edge barely making a living and eighty out of every hundred last only seven years or less

Yet fighting against all those odds and with all this apparent inefficiency and expensive distribution we do have groceries and good groceries too and we also have many good business men who have studied the conditions of the sale and distribution of foodstuffs with the worthy object of making the business less hazardous for the proprietors, and increasing the convenience and lowering the cost to the customers

Taking the store to the customers is not particularly a new idea in itself but the store on wheels as conceived by L B Watson and worked out with the assistance of M I Pulcher is a long step towards solving many of these questions In the first place the "Mototeria is a serve-self store on wheels capable of serving 400 families per day with a complete stock of groceries, breads and cakes, fruits green and staple vegetables meats and drug sundries It has but one clerk who is also cashier as well as driver His store is 22 feet long by 7½ feet wide, yet so conveniently are the commodities arranged each with its own price tag, and so easy to operate is the overhead basket carrier device that ten or twelve customers can wait on themselves at one time If the housewife has babies and no help it is quite impossible for her to go to the store down the street but here is a well stocked low priced "chain store" right at her door where she can get her "items" and be out of the house but a few minutes

That is well enough you say but these women have to pay extra for this service don't they? Well that is just what Mr Watson determined to find out The result was much thinking and a study and planning and a thorough analysis of the field which it was intended to cover The first unit was built and stocked complete including everything that a chain store would carry but having several features borrowed from the old neighborhood shop thrown in by way of good measure The first unit was put to work in Detroit last August To the gratification of Mr Watson and Mr Pulcher the shoppers took it up immediately While they had appreciated the chain store with its lower prices yet they had had to carry the goods some distance which was usually a bother Here was a store which was lighted and heated, neat clean and sanitary—but best of all with everything needed for breakfast lunch or dinner and with good savings on each item Naturally the women liked it—and the operators were both surprised and pleased over it

General appearance of the grocery store on wheels

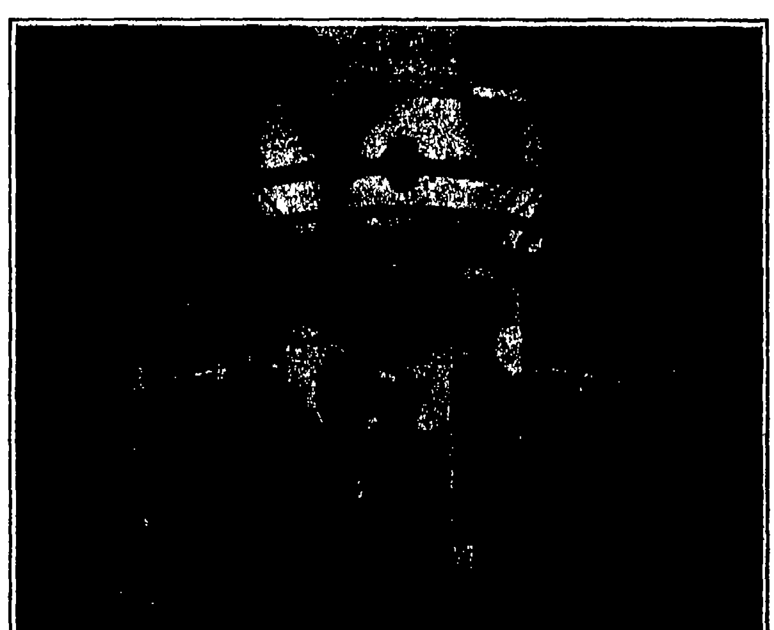
Where the average chain store receipts were under $500 per week the Mototeria started doing a $1 000 business per week before it had been long on the route Further by a reduction in clerk hire savings in rent light, heat window displays and other items, the profit increased from 3 per cent to 12 per cent even when the retail prices were kept equal to the chain store prices Instead of drawing an indifferent trade from a radius of three to five blocks this store visited the families in 35 to 40 blocks every day

Further, it was found that the turnover possible by increasing the number of customers was almost unheard of in the grocery or meat trade The turnover of the usual chain store is thirteen times per year, while a ten-cent store turnover averages 24 times The Mototeria turns its stock 100 times yearly Daily replenishment was found to lighten the load and permitted carrying of a greater variety as well as assuring fresh stocks at all times

The Mototeria carries assorted meats, but mostly cold meats for immediate use, because of lack of cutting facilities Its meat-order system however, is a great convenience and saving to both operator and customer Meats are ordered one day for the next These are cut exactly as ordered both as to the particular cut and also as to the weight in a central, sanitary refrigerating plant and wrapped and labeled for delivery to the customer It has been estimated that an operator with eighty such stores could save $60 000 per year on efficient meat cutting alone, and another $60 000 for truck hire for trucks now used in supplying the regular stores

A plate glass show window in the rear of the Mototeria provides display of green groceries and fruits Potatoes and other bulk vegetables are sacked in varying quantities in bins all ready for the customers In winter the Mototeria is heated by a novel system utilizing the hot water from the engine This eliminates the "gas smell" noticeable with the use of exhaust heaters The store is ventilated by a device for that purpose in the roof

It is also planned to have a laundry pick up with one or two day service in connection with the Mototeria Large compartments are provided in the body for this purpose A banking system which is done by a stamp and card system has also been worked out by the designers of the new store which has many interesting phases The taking of coal orders with one day service is still another plan which may have many economic sides Indeed it is well within the probabilities that this system of household service with its many attractive features may revolutionize our whole scheme of food and household necessity distribution and it is within reason that the bulk of the purchases for the household will be done in future right at the door



The man in charge is really a chauffeur-cashier, rather than a clerk

Washington Memorial Bridge at Wilmington

THE handsome monumental bridge across the historical Brandywine Creek in the City of Delaware, herewith illustrated, constitutes a memorial to the Delaware soldiers and sailors of the Nation's wars and especially of the World War. Situated in the North central part of the city, this bridge enhancing the beauty of the natural scenery in a locality that was the theater of stirring events during the war of the Revolution, and which is inseparably associated with the name of General Washington, not only commemorates the patriotism of the citizens of the State of Delaware, but also serves to carry the important vehicular traffic of the Washington Boulevard.

The new bridge is 720 feet long and 72 feet wide and consists of five reinforced concrete arch spans: two 70 feet in length, one 250 feet, and two 85 feet in length, together with the necessary approaches. Each span consists of three arch ribs, 11 feet, 16 feet and 11 feet wide respectively. The deck of the bridge consists of a 40-foot roadway paved with sheet asphalt, two sidewalks 14 feet, 9½ inches in width and two balustrades or railings 1 foot, 2½ inches in width.

The piers of the bridge are on a 30-degree skew, and the large 250-foot span of 40-foot rise is probably the longest, low rise skew arch span in the United States, if not in the world.

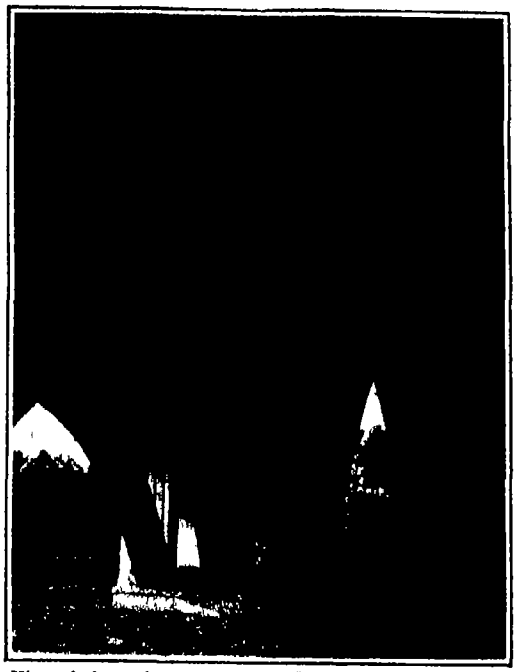
While the character and design of the entire bridge is of a decided memorial nature, the distinctive memorial features are embodied in large bronze tablets placed on four monumental pylons or shafts. There are four of these large bronze tablets, all 9 feet high by 5 feet wide, and each with a different inscription. One tablet commemorates the Revolutionary War, one commemorates the War of 1812, the Mexican, Civil and Spanish American Wars, and two tablets commemorate the World War, one having the names of the great battles in which Delaware Troops fought, and the other bearing the names of all those service men from the entire State of Delaware who made the supreme sacrifice in the last Great War.

There are eight of the large ornamental pylons or shafts placed on the bridge in line with the railings. Four of the larger shafts are placed over the piers of the large central arch and two of the smaller shafts at each end of the bridge. The large shafts extend 40 feet above the sidewalk level and the smaller shafts 23½ feet. The bronze tablets are placed on the inside faces of the shafts where they can be viewed by pedestrians on the sidewalks. On the inside faces of the smaller shafts are placed bronze nameplates measuring 3 feet by 4 feet. On each side of the large shafts and on the approach sides of the small shafts are placed large ornamental bronze lanterns, which are illuminated by a single incandescent Mazda lamp of 250 candle power. On the inside and outside faces of the large shafts are placed carved Onondaga Litholite eagles and shields of a monumental character.

At the center of the span of the large arch a refuge bay was provided on both sides of the bridge by extending the sidewalks slightly beyond the line of the railing, thus forming a vantage point from which pedestrians might pause and view the park below. Refuge bays were also provided at both ends of the bridge. Large ornamental precast stone urns were placed on the end posts of the railing of the refuge bays at the north end of the bridge. The lighting system of the bridge was arranged so as to harmonize with the pylons and railings from an architectural standpoint, as well as to give the proper lighting effect to the sidewalks and roadway at night. The main lighting system consists of twenty-eight luminous arc lights supported by cast iron light poles placed on the curb line of the bridge. The secondary lighting system consists of the incandescent Mazda lamps in the twelve large bronze lanterns placed on the shafts and the two bronze standards at the stairway. The two lighting systems are on independent circuits.

The bridge was designed to carry the heaviest modern highway traffic, and liberal provision was made for impact and possible future increases in traffic requirements. The assumed loads used in the design were 60-ton electric railway cars placed on the double tracks, a line of 20-ton motor trucks on the roadway at each side of the tracks and a sidewalk load of 100 pounds per square foot.

The designs for the bridge were prepared by Mr. Benjamin H. Davis, Consulting Engineer of New York City, assisted by Mr. Vance W. Torbet, Architect. Mr. Davis informs us that the cost of making a purely utilitarian bridge further serve as a war memorial was in this case, approximately $56,550, this being less than 8 per cent of the entire cost of the structure. A memorial bridge daily serving the needs of a community yet at the same time commemorating the unselfish services of these citizens who rallied to the aid of their country in her hour of need offers to cities and towns a fitting and economical solution of their war memorial problems.



View below the 250 foot arch, showing the three massive ribs which carry the floor of the bridge

The Washington Memorial bridge at Wilmington, dedicated to the Delaware soldiers and sailors of the Nation's wars from the founding of the Republic to the World War

Human Behavior and Reflexes

THE basis of nervous activity is formed by so-called reflexes and instincts. The instincts are complex reflexes. The instincts—inborn associations with definite stimulators—correspond to the activities of the organism. On this basis are built the highest nervous activities.

If the action of any indifferent agent coincides in time with the action of an instinct and if the action of the agent is repeated many times then this agent formerly indifferent begins to stimulate the instinct. For example, food stimulates the food reaction which consists of some movements of the animal and secretion. But if some indifferent agent which previously had nothing in common with feeding is repeated many times with the feeding after a time it begins to stimulate the food reaction when used alone. Thus if we produce some distinct musical sound at a given rate of frequency of vibration per second—and always at the same time feed a dog after a while this sound, used alone, will produce the same food reaction as the food itself. Such stimulators may be formed from any agent of the outer world and with any other instinct. In this way, besides the reflexes or instincts which are inborn, some reflexes are acquired during the life of the individual. The first or inborn reflexes we call unconditioned reflexes and the second, or acquired, reflexes we call conditioned.

It is clear that the conditioned reflexes play a very important part in our behavior as they are being acquired during the entire life time of the individual.

Conditioned stimulators serve as signals separate from the unconditioned stimulators but like any other signals they may not signalize properly. Then they are to be corrected. For instance, in the experiments mentioned the sound produced by one thousand vibrations per second was made a conditioned stimulator. If the sound is repeated without the simultaneous feeding of the dog, then for some time the sound loses its stimulating action. But this need not destroy the conditioned reflexes for sometimes the stimulating action returns again. Secondly, if the conditioned stimulator is combined with another agent—any other agent—and is not at the same time combined with feeding then the conditioned reflex loses its stimulating action. In both these cases we deal with inhibition. In this way the process of inhibition always accompanies the activity of the highest nervous centers.

The process of inhibition exists also for another end. It helps to differentiate the various stimulations from the outer world. For example let us form from the sound caused by one thousand vibrations per second a conditioned stimulator for the food reaction, which means that this sound always produces the ordinary food reaction or the secretion of saliva. After this secretion reaction is formed to this particular sound all the sounds of the neighboring frequencies, say 900 vibrations or 1100 vibrations, will also produce the same effect; that is all the sounds of nearly the same frequency acted as stimulators for food reaction. If however we always produce only sounds caused by *one thousand vibrations with the feeding of the dog,* carefully excluding all the other sounds after a time all the other sounds will lose their stimulating action and only the one sound will act as a stimulator for the food reaction. It is in this way that the limit of the differentiating ability of the dog or of any other animal may be very easily found.

Conditioned reflexes and differentiation make up the whole activity of the nervous system. It is also interesting to point out that recently we have proved that the process of inhibition is exactly the same process as that of sleep. The differentiating inhibition in sleep is divided into small parts and sleep is diffused continuous inhibition. Thus there is no marked contrast between the normal active state and the sleepy state.—*Abstract from article by Prof. I. P. Pavlow of Petrograd, Science, November 9, 1923.*

Farmyard Manure and Artificial Fertilizers

SIR JOHN RUSSELL, in discussing Agricultural Science as studied at the *Rothamsted Experimental Station* said, in a lecture before the Royal Institution on February 9, 1923, concerning the difference between farmyard manure and artificial fertilizers: "Farmyard manure and also plant residues (which are substantially the same thing) decompose in the soil giving rise to many substances of different types. The plant foods are among the end products indeed, in natural conditions and to a large extent in farms and gardens also it is in this way that plants obtain their food. In using artificial manures we supply these end products at once instead of waiting for them to be liberated gradually by the natural decomposition. Further we do not by any means know the whole of the processes whereby plant food is made. But there are certain intermediate products, and it is quite possible that some of these may have a special effect on the growing plant. Curious stimulating effects are produced by substances formed when soil is steamed or when oxidation is accelerated by addition of charcoal and small quantities of picric acid."

Post-Treaty Standing of the World's Navies

The Urgent Need for Additional Unarmored Craft to Round Out the U. S. Navy

THE drawing on the opposite page represents the relative strength of the leading Navies of the world in unarmored ships. No battleships or battle cruisers are shown, the Washington Conference having determined a ratio in these ships of 5-5-3-1.7 and 1.7 respectively for the United States, Great Britain, Japan, France and Italy. Of light cruisers, flotilla leaders and destroyers it was proposed that the United States be allowed 450,000 tons, Great Britain 450,000 tons, Japan 270,000 tons and France and Italy proportionately. In submarines the proposed totals were 90,000 tons, 90,000 tons, 54,000 tons and so forth. Ultimately, these restrictions on unarmored craft were abandoned. It will be seen that the United States Navy suffers from a very great shortage in light cruisers and possesses not a single flotilla leader.

THE Washington Treaty of Naval Limitation will always be regarded as one of the greatest works of constructive statesmanship in the world's history. At a single stroke it killed a vicious and mendacious propaganda which was producing that combination of suspicion, fear and hatred whose natural and inevitable child is war. By the terms of the treaty the United States, Great Britain, Japan, France and Italy agreed to avoid any ruinous competition and reduce their enormous and costly battleship fleets to a ratio of strength of five for the United States, five for Great Britain, three for Japan, 1.7 for France and 1.7 for Italy. Under the treaty the tonnage allowable for the United States is 18 battleships of 525,850 tons total displacement; for Great Britain 20 battleships of 582,725 tons (to be early reduced to 18 ships and 525,850 tons) and for Japan 10 battleships of 313,300 tons. All armored ships, both dreadnaughts and predreadnaughts not included in the above totals were to be destroyed, as were also all armored ships that were being built and were not yet completed. Furthermore no new battleships were to be built for a period of ten years.

Subsequently, at the urgent request of the Japanese, the battleship Mutsu (of about the same size and power as the Maryland) which was practically completed, was permitted to remain on the Japanese lists on condition that the United States be permitted to complete two ships of the Maryland class and that Great Britain be allowed to build two battleships up to the limit of 35,000 tons imposed by the treaty. In order that the total limitations of battleship displacement be not exceeded the three nations were required to destroy certain of their older battleships as soon as these additional ships were completed.

Most important in its effect on the cost of Naval armament was the reservation regarding the size of future capital ships, which as we have said was placed at 35,000 tons. The rapidly increasing size of the battleship and battlecruiser was one of the most alarming facts of the Naval problem. Under the spur of competition each Navy aimed to outbuild the existing ships of other Navies in speed, gun power, protection, steaming radius, etc., with the result that the displacement had moved up in ten to twelve years time from the 20,000-ton North Dakota to the 28,000-ton 'Queen Elizabeth,' the 32,600-ton Maryland and the 42,000-ton 'Hood.' Henceforth preponderance of power can no longer be obtained by larger increases of displacement. The most effective battleship built under the treaty will be the one which combines in the best proportions the various elements of power above enumerated.

It was the aim of the sponsors for the Naval treaty to make it apply to all classes of fighting craft, but because of certain opposition that developed the limitation clauses were not made to extend in any such sweeping measure to unarmored craft or as they were termed "auxiliary fighting craft." In the agreement the last named were divided under three heads: auxiliary surface craft, submarines, and aircraft carriers and aircraft. Under surface fighting craft are included cruisers (with the exception of battle cruisers), destroyer flotilla leaders, destroyers and all other surface types (except existing monitors and unarmored surface craft under 3000 tons), fuel ships, supply ships, tenders, repair ships, mine sweepers and merchant vessels readily converted into vessels of war. It was proposed that the total tonnage of cruisers, flotilla leaders and destroyers allowed each power should be: United States and Great Britain each 450,000 tons; Japan 270,000 tons. The allowance of submarines was for the United States and Great Britain each 90,000 tons, and for Japan 54,000 tons. Of aircraft carriers the United States and Great Britain were each allowed 80,000 tons and Japan 48,000 tons. Because of the fact that Naval aircraft may be readily adapted from special types of commercial aircraft, Congress did not consider that it was practical to prescribe any limit for these.

Unfortunately in the discussions that followed the proposals as to cruisers and other auxiliaries the restrictions as to these auxiliary craft were abandoned.

On the adjoining page is shown the present unarmored strength of the Nations that have signed the Naval Treaty. It serves to show at a glance where the United States is strong and where it is weak in the various types of vessels dealt with. The most important ships are those in the upper half of the page, which are grouped under the caption 'first line ships.' Of equal importance perhaps (Admiral Sims and a few others of our Naval officers would say of greater importance) are the ships shown with the caption 'aircraft carriers.' The second line ships because of their age are of minor importance.

Frequently during the past twenty years the SCIENTIFIC AMERICAN has urged that our Navy is top heavy in so far as we have put our displacement into battleships to the neglect of other types. The most serious weakness of our fleet is our shortage of fast light cruisers of 8000 tons and over. Unless we include the ten vessels of the Richmond class which, although they were designed to be of 7500 tons displacement have been so greatly increased in armament (50 per cent increase) and in strength of hull that they displace today about 9000 tons—we have no light cruisers of the first class. However we have put these ten ships in the class of light cruisers of from 3000 to 8000 tons, and this leaves us without any in the 8000 tons plus class in which the British have six ships, Japan four, France three and Italy two. In the 3000 plus class, we have these ten ships and it is some consolation to know that in speed and power (each carries 12 six inch guns) they are incomparably superior to ships of the same class in other Navies. Great Britain has 35 ships in the 3000 plus class including many fine and modern vessels, but a considerable proportion of them are rather old as vessels go. Japan has 23 ships, France has three and Italy five. When we come to destroyer leaders, we are hard hit, for we have not a single vessel of this most important class, whereas Great Britain has 18, France seven and Italy eight.

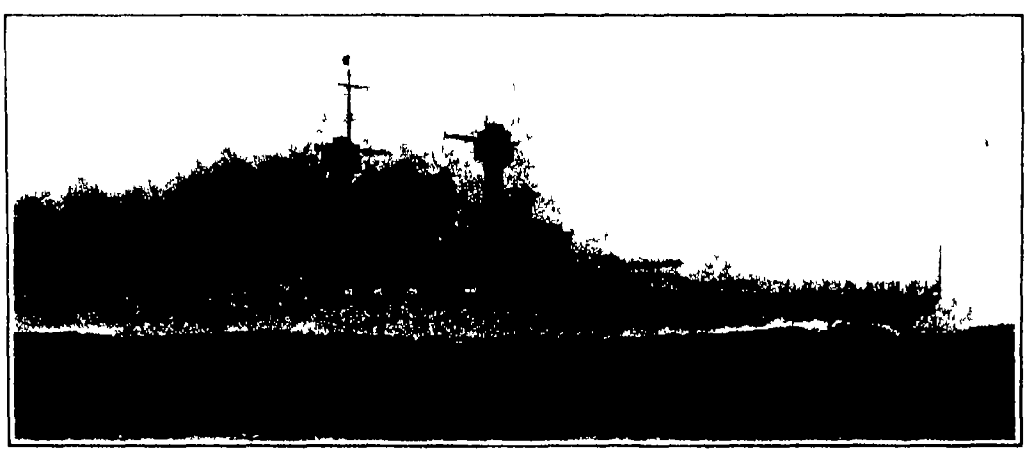
In the class of 800 to 1500 ton destroyers, we have a most impressive lead, all of our ships being newly built during the war and showing a speed on trial of 34 to 35 knots. In submarines of 500 to 1000-tons displace

(Continued on page 367)

Our Latest Battleship—the "Colorado"

THERE are many facts connected with the United States battleship 'Colorado' which make her of special interest to the American public. In the first place her displacement of 32,600 tons (normal) renders her the biggest battleship afloat, a distinction which she shares with her two sister ships the Maryland and West Virginia. The British Hood is larger by 9800 tons, but she is more battlecruiser than battleship and indeed is so listed by the British themselves.

Not only is the Colorado the largest, but she is among the most heavily armed battleships, since she carries eight 16-inch 45-caliber guns. This is a more powerful battery than that of the Royal Sovereign and "Queen Elizabeth" classes which mount eight 42-caliber 15-inch guns as their main armament. Another point of superiority is the defensive arrangements of the Colorado, both as regards heavy armor and underwater subdivision. The armor plan includes 13½ inch side armor, 18 to 9 inch turret armor, and heavy armor around the bases of the smokestacks. The underwater protection is superb, the hull between the engine rooms and the water being made up of no less than five separate watertight shells (longitudinal bulkheads) designed to receive the blow of the torpedo and dissipate the disruptive power of its gases before they can get through to the engine rooms, the boiler rooms, the magazines or other vitals of the ships.



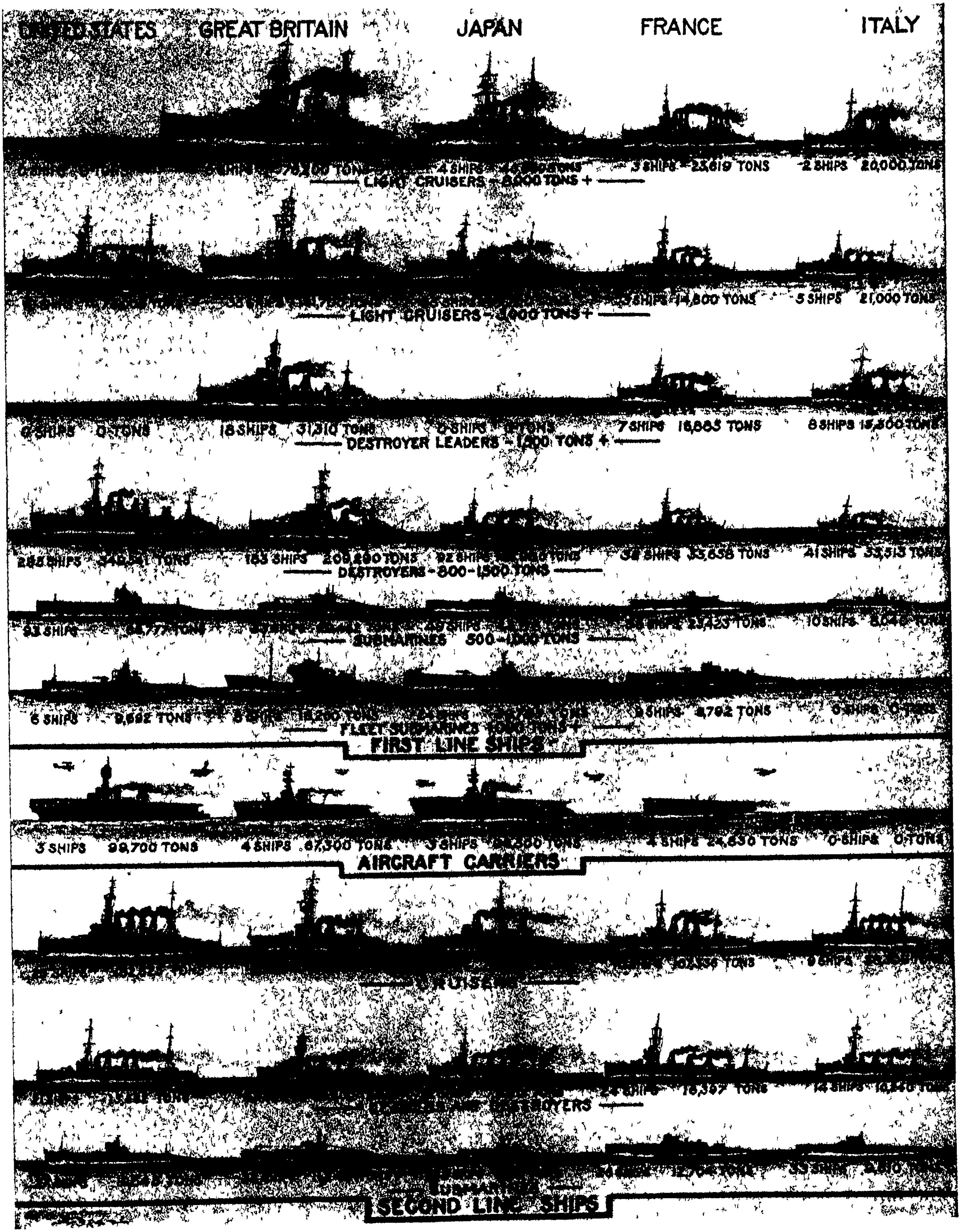
Displacement 32,600 tons. Speed, 21.87. Guns: Eight 16-inch, twelve 5 inch. Armor: Belt, 13½ inch; turrets, 18-inch to 9 inch; torpedo tubes, 2 submerged.

Our latest Battleship "Colorado"

The speed of the "Colorado" in her recent trials over the official measured mile at Rockland, Maine, was 21.87 knots. Before undergoing these trials she was sent on a shaking down trip to Europe where she attracted wide attention and was a subject of very favorable comment. She is indeed a very handsome and imposing ship. With her long and lofty spar deck, towering bridge structure and formidable looking housed-in tops she presents a truly majestic Naval picture.

If we have any criticism to make of the "Colorado" and her sisters, it is that too much of their armor is vertical and too little of it horizontal. A few inches taken from the side armor and judiciously placed above the magazines would render these ships better protected against the steeply falling shells of a long range bombardment. Similarly a few inches taken from the port plate of the turrets and placed upon the roofs, would render the sixteen inch guns more secure than they are now against turret penetration. However, all existing ships in any Navy of the world are open to the same criticism.

Another interesting fact about the "Colorado," is the fact that she is the last battleship that we shall build for some years to come, that is to say, until the Washington Treaty Limitation has expired. The limit of size of that treaty is expressed in displacement, and it stands at 35,000 tons. Great Britain, as an offset to our completion of the "Maryland" class, was permitted to build two battleships.

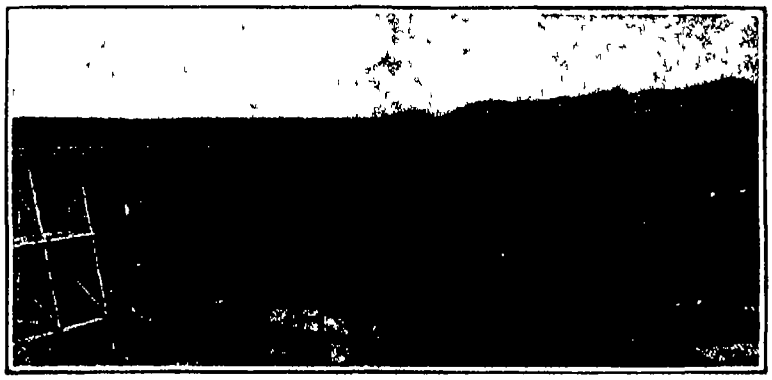

GREAT BRITAIN
JAPAN
FRANCE
ITALY
3 SHIPS 23,619 TONS
2 SHIPS 20,000 TONS
5 SHIPS 21,000 TONS
LIGHT CRUISERS
0 SHIPS 0 TONS
18 SHIPS 31,310 TONS
7 SHIPS 16,865 TONS
DESTROYER LEADERS
153 SHIPS
36 SHIPS 33,658 TONS
DESTROYERS - 800-1,500 TONS
10 SHIPS 8,046 TONS
SUBMARINES 500-1,000 TONS
6 SHIPS 9,692 TONS
9 SHIPS 4,792 TONS
FLEET SUBMARINES
FIRST LINE SHIPS
3 SHIPS 99,700 TONS
4 SHIPS 67,300 TONS
4 SHIPS 24,630 TONS
0 SHIPS 0 TONS
AIRCRAFT CARRIERS
CRUISERS
24 SHIPS 18,397 TONS
14 SHIPS 10,840 TONS
DESTROYERS
SECOND LINE SHIPS

Insular Irrigation

Hawaii Finds It Necessary to Control Her Water Supply

By Arthur L Dahl

WHEN we think of Hawaii we are apt to consider it the garden spot of the world where Nature has arranged everything to produce the most luxuriant growth with the slightest effort of man This is true to a limited extent for climatic conditions are ideal for most tropical crops but the ingenuity of man has been called into play to insure, in many parts of the islands, the necessary irrigation waters for the fields of sugar cane rice or other native products for while copious rains fall in the high mountains some of the low lands do not get a sufficient supply of water throughout the growing season to supply the crops with moisture Therefore the plantation engineers have gone into the recesses of the mountains and have built flumes and conduits to carry the surplus waters to where they will do the most good



The flume in one of the leading Hawaiian water developments

Hawaii is a country of contrasts for at many points towering mountains rise almost out of the sea while at others the sandy shore rises slowly from the ocean level, and vast fields are available for growing crops, if a sustained water supply is provided

A number of sugar companies on the island of Maui formed a cooperative company and at an expenditure of over a million dollars developed a water system for the sugar fields that brings the rains from the mountain slopes of East Maui through a system of canals and tunnels over 40 miles long to irrigate the cane fields The more available of these sources were tapped by the old Hamakua ditch and by the Haiku ditch over twenty years ago but as the need for more water increased the ditch system penetrated many miles further into the mountains The latest Kauhikoa ditch consists almost entirely of tunnels through the solid rock for out of 23,500 feet of this new construction only 700 feet consists of open ditch the remaining 22 800 feet being beneath the surface The ditches are six feet wide and the tunnels are seven feet high The water in this ditch is passed across the great Maliko gulch through an inverted siphon pipe 22 inches in diameter and 85 feet in length The longest tunnel on this ditch is over 3000 feet in length

Irrigation ditch through a field of sugar cane

The mountain slopes of Hawaii are so precipitous that very little of storage facilities is afforded and during the middle of the dry season it is often necessary for the sugar companies to supplement the water supply obtained from the mountains by pumping water from wells sunk at various points throughout the fields One plantation has installed pumping plants capable of raising 80 000 000 gallons of water a day, and the same company installed a hydroelectric plant in connection with its mountain ditch system capable of generating 875 horsepower which power was used to operate pumps that elevated 6 500 000 gallons of water daily to a height of 574 feet and then released to irrigate the cane fields

Another sugar company on the island of Maui has harnessed the waters from the mountains back of the cane fields and in the process of bringing 5 000 000 gallons of water each day to irrigate the land sufficient electric power is generated by the falling waters to light all of the plantation buildings and supply power to pump 1 500,000 gallons of water from wells

The Honokahau ditch in West Maui supplies about 50 000 000 gallons of water daily which is brought from the Honokahau Valley, a distance of some seven miles The canal consists of 6½ miles of tunnels 400 feet of open ditch and 1200 feet of 36 inch siphon pipe The entire ditch and tunnels are concrete lined and in the construction of this system many engineering difficulties had to be overcome, owing to the rugged and almost inaccessible character of the country In building this ditch it was also possible to generate electric current for one of the ditches reached the plantation far above the area of cultivation and a generating plant was installed to utilize the power drop without interfering with the use of the water for irrigation The town of Lahaina is lighted from this hydroelectric power plant, and there is plenty of current to spare.

The cane fields of the Hawaiian Commercial and Sugar Company the largest sugar company in the islands, are watered principally by a great canal and ditch which brings water from the mountains of East Maui, a distance of over 50 miles The upper reaches of these mountains are rain soaked practically all the time and by a system of four ditches heading into the wet area a constant supply of water is obtained and carried to the drier region below Practically all of the ditch line is made up of tunnels, which are cement lined and cost over half a million dollars to construct To supplement the water supply during the periods when the rains fail, the company has developed a system of pumping plants to take water from the many subterranean reservoirs which lie under the fields

Sugar mills at Hakalau, deriving their cane from irrigated fields

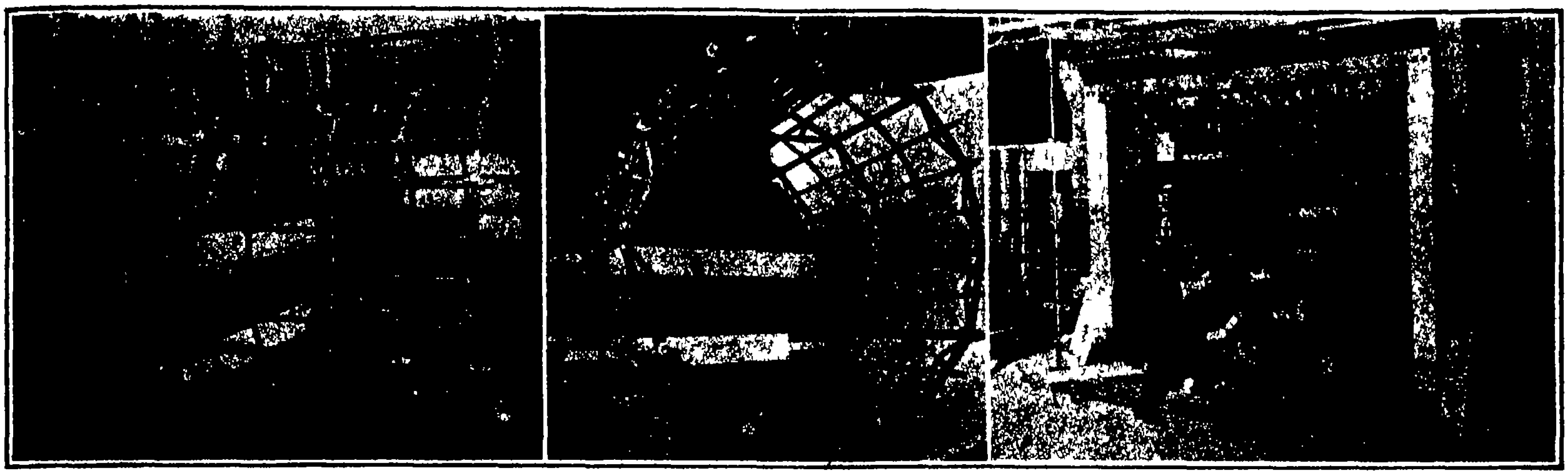
In the process of bringing irrigation waters to the low lands, some of the companies have found it necessary to construct long trestles to support the flumes across canyons or low depressions, and throughout the islands visitors can see these frameworks that support the lifegiving waters that are brought from the rainsoaked slopes of the mountains to the dry areas below One of them is illustrated

While natural reservoir sites are scarce yet in some instances these have been found and have been developed to regulate the flow of irrigation waters throughout the year In one district the construction of a reservoir high in the mountains enabled a plantation to cultivate an additional area of cane land, and thus more than pay for the cost of the reservoir system

Nature, through her trade winds blowing almost constantly against the high westward sides of the mountains, supplies an excessive rainfall to those regions while on the low lands protected by the shoulder of those same mountains the sun shines without interruption during the many months of the dry season Man by harnessing the rainsoaked slopes, and bringing into captivity the lifegiving waters has made the low lands blossom with sugar cane and rice and the other things which furnish food for people, and the work is still going on, so that eventually every drop of water will be put to beneficent use

The Sense of Time

IN the Proceedings of the Society for Psychical Research (British) for July, Mr S E Hooper has an article with the title "An Experimental Study of the Appreciation of Time by Somnambules" It is known that some hypnotic subjects display what appears to be a supernormal power of appreciating the passage of time If, for example, such a subject is told during hypnosis to perform some simple act at the end of 5000 minutes he will do so at or about the correct time although in the period intervening between the hypnosis and the performance of the act he has had no conscious knowledge of the suggestion that has been given to him Experiments demonstrating this peculiarity of the hypnotic state have been recorded by Gurney, Delboeuf Bramwell and Mitchell and Mr Hooper takes up the inquiry at the point at which it was left by these observers Two main problems are presented by the results of these experiments (1) the subliminal calculation by which the subject comes to know the time at which the suggested act is to be performed (2) "true time-appreciation by which the subject knows when the time so calculated arrives. When a long time-interval is given in minutes the subject usually calculates subliminally so as to find out when the suggested act falls due Mr Hooper's experiments corroborate this but one of his subjects maintained that as soon as the suggestion was given she began to count rhythmically and continued to do so until the suggested number of minutes had elapsed It is to such a capacity for accurate counting of seconds by a subconsciousness on which the pendular rhythm of the clock has been faithfully inscribed that Mr Hooper looks for an explanation of "true time-appreciation"



Three views of the celluloid model of the "Shenandoah," used in the novel stress tests Polarized light is passed through the various members while under stress, and the nature and magnitude of the pull or push which they must withstand is shown by the rainbow colors of the resulting image

Translating Stresses Into Color for Visual Observation

THE Bureau of Aeronautics of the Navy Department has made a study of a celluloid model of the air ship "Shenandoah" by means of photoelastic methods The work was done in the laboratories of the *Massachusetts Institute of Technology* No definite statement of the results of the tests can be made but Navy Department officials have expressed themselves as well pleased with the data obtained It is believed that *these tests will be of 'distinct value' and of* material aid in the design of airships to prevent a repetition of the ZR 2 and 'Roma disasters

The model consists of several thousand pieces of celluloid machined precisely to scale and fitted together in a miniature duplicate of the airship The testing was performed in the photoelastic laboratory of the Department of Physics by Dr Paul Heymans and T H Frost, of the Technology staff, under the general supervision of Professor Charles I Norton of the Department of Physics

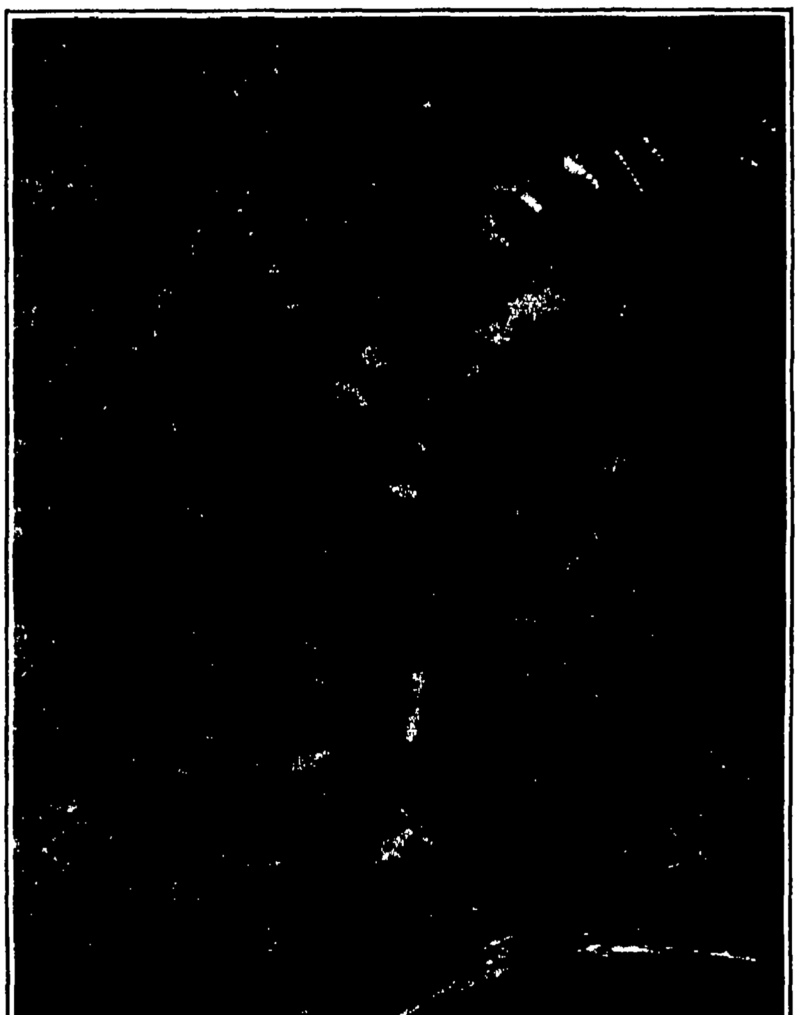
The phenomena of photoelasticity have been known to science for some time but have been employed only recently to settle troublesome problems of structural design, many of which cannot be mathematically determined By this method polarized light is passed through the celluloid of the model under different loading conditions, and the stresses appear in rainbow colors Since celluloid *acts structurally as do metals* used in construction it is possible by varying the loads on the laboratory model, to determine just how the airship itself will act under various conditions

As Prof Heymans states "By this photoelastic method we can look into the vast and intricate network of the dirigible and see exactly what is going on when it is laboring We can see how she is carrying and distributing the load We have made an analysis of the Shenandoah, saying exactly how the stresses are taken up by the members of the frame and the wires When we hear of new forces which the ship must meet in its ventures overhead we can try them out on the model here at Technology "

Vision and Man's Mental Powers

THE first step in the evolution of man's mental powers was taken when in a very primitive and unspecialized arboreal mammal vision became the dominant sense, by which movements were guided and behavior was largely determined One of the immediate results of the enhancement of the importance of vision was to awaken the animal s curiosity concerning the things it saw around it Hence it was prompted to handle them and its hands were guided by visual control in doing so This brought about not merely increased skill in movement, but also the cultivation of the tactile and kinaesthetic senses, and the building up of an empirical knowledge of the world around it by a correlation of the information obtained experimentally by vision, touch and movement The acquisition of greater skill affected not merely the hands but also the cerebral mechanisms that regulate all movements and one of the ways in which this was expressed was in the attainment of a wider range and an increased precision of the conjugate movements of the eyes and especially of a more accurate control of convergence This did not occur, however, until the flattening of the face (reduction of the snout) allowed the eyes to come to the front of the head and look forward so that the visual fields overlapped Moreover, a very complicated mechanism had to be developed in the brain before these delicate associated movements of the eyes could be effected The building up of the instrument for regulating these eye-movements was the fundamental factor in the evolution of man s ancestors which opened the way for the wider vision and the power of looking forward that are so pre-eminently distinctive of the human intellect Our common speech is permeated with the symbolism that proclaims the influence of vision in our intellectual life

The first stage in this process seems to have been the expansion of the prefrontal cortex and the acquisition of the power of voluntarily extending the range of conjugate movements of the eyes and focusing them upon any object Then came the laborious process of building up in the midbrain the instrument for effecting these complex adjustments automatically so that the animal was then able to fix its gaze upon an object and to concentrate its attention upon the thing seen rather than upon the muscular act incidental to the process of seeing it This represents the germ of attention and mental concentration in general But the power of automatically moving the eyes with such accuracy that the images of an object upon the two retinae could be focused with precision upon exactly corresponding spots made possible the acquisition of stereoscopic vision the ability to appreciate the form size solidity and exact position in space of objects Hence at this time probably for the first time in the history of living creatures an animal acquired the power of seeing, in the sense that we associate with that verb The attainment of these new powers of exact vision further stimulated the animal s curiosity to examine and handle the objects around it and provided a more efficient control of the hands so that acts of increasing degrees of skill were learned and much more delicate powers of tac*tile discrimination were acquired* Out of these experiments also there emerged a fuller appreciation of the nature of the objects seen and handled and of the natural forces that influenced the course of events—*Abstracts from address by Professor G Elliot Smith F R S, before the British Association September, 1923*



Submarine photograph taken from high in the air

Under-Water Photographs from the Air

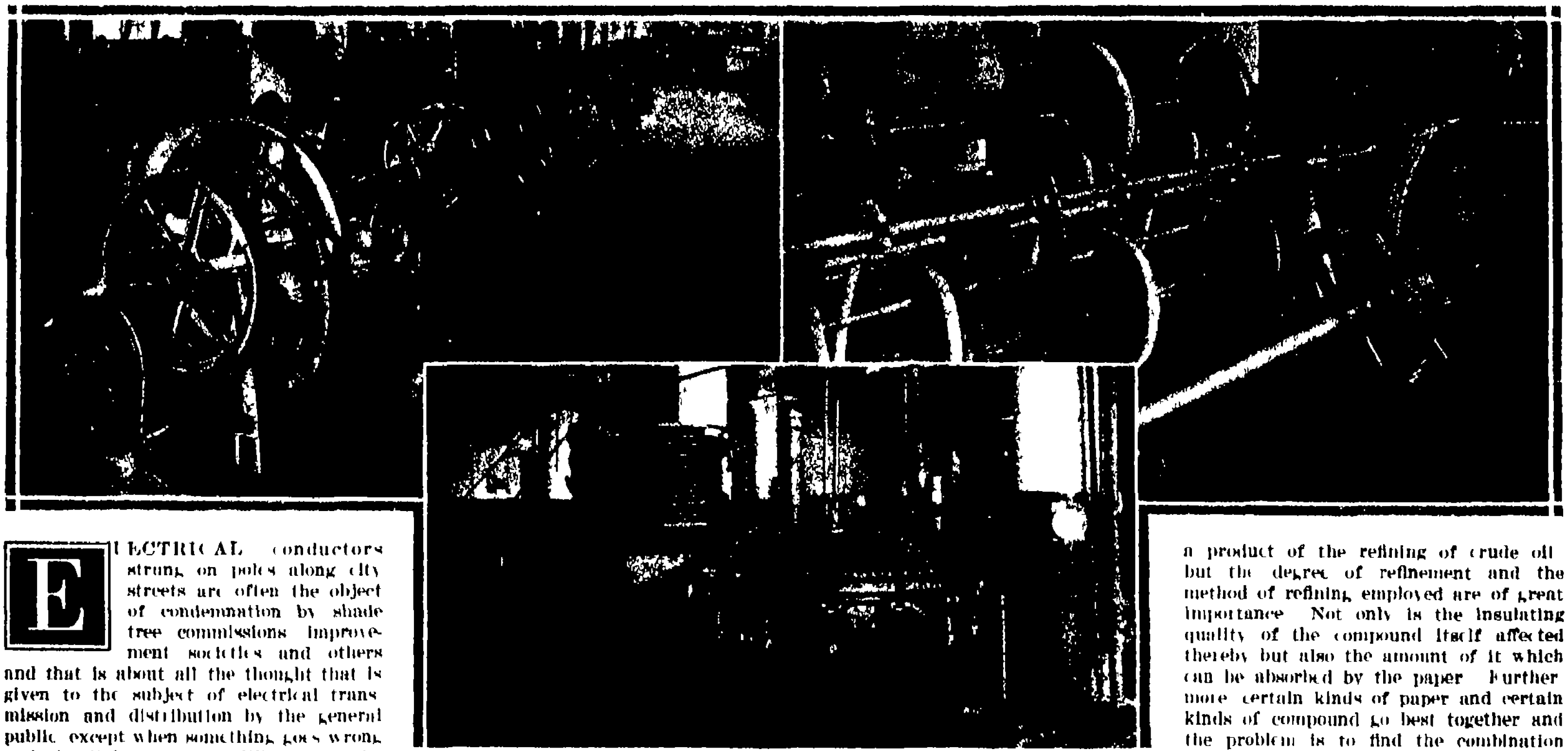
THE airplane has opened up new worlds One of them is a submarine world Aviators flying hundreds of feet above a body of water can see submerged objects far beneath the surface This is why aircraft were the deadly enemies of submarines during the late war and why airplanes are now used to locate shoals of fish

And the camera when equipped with the right kind of plates and ray filters, can penetrate the water even more successfully than the human eye Objects submerged more than fifty feet have been photographed from an airplane Hence it is now possible to make a rapid photographic survey of shoal waterways. Rivers like the Mississippi with ever shifting bars will hereafter be made safe by monthly or weekly mapping from the air In earthquake regions, such as southern Italy and Japan, the changing coast line shallows and harbors can easily be photographed after each new quake thus keeping navigation open and conserving lives

Making High-Tension Cables

From Old Rope and Oil Waste to Leak-Proof Conductors of Current

By Francis A. Westbrook, M.E.



Left: The sector stranding machine which coils the individual strands of wire into cable. *Right*: Winding the paper insulation off its spools and on to the cable. *Below*: The impregnating tanks

Three stages in the manufacture of paper wound, oil impregnated, electric cable for underground transmission of current

ELECTRICAL conductors strung on poles along city streets are often the object of condemnation by shade tree commissions, improvement societies and others and that is about all the thought that is given to the subject of electrical transmission and distribution by the general public except when something goes wrong and the lights go out. When once the conductors are placed out of sight below the surface of the ground everybody heaves a sigh of relief and forgets about them except the engineers who have to transmit the power over them and the manufacturers who have to make them.

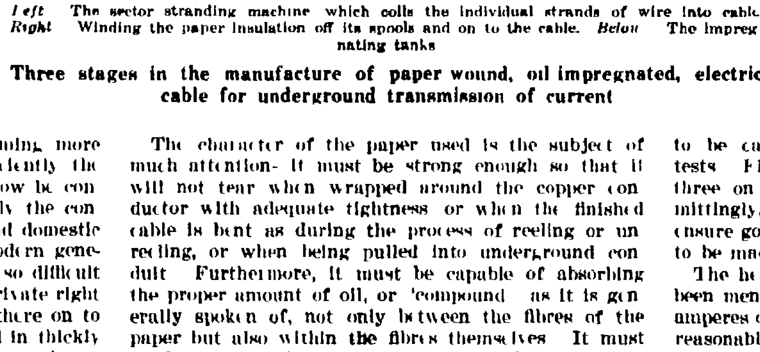
The engineers worry because it is becoming more and more of a problem how to carry efficiently the immense blocks of power which must somehow be conveyed from the generating stations to supply the continually increasing demands of industrial and domestic consumers. When one of the very new modern generating stations is put into service, it is not so difficult to build a steel tower transmission line on private right of way as far as the city limits but from there on to the various substations of necessity located in thickly populated areas it is a very different matter. As no city will permit very high voltage overhead lines it is imperative to install the conductors underground and this greatly complicates the problems of insulation.

It is not yet possible to make insulated cables for very high voltages when compared to those used for open wire lines. On the other hand the voltage must be kept up reasonably high because it is not possible to transmit electrical power economically at low voltage. Consequently the central station engineers are clamoring for higher and higher voltage cables and the manufacturing engineers are wrestling with the problem of how to make them.

The highest voltage underground cables in commercial service are for 45,000 and some at 60,000 will soon be in operation but even this is not very high when compared to the 220,000 volt aerial transmission lines now giving satisfactory results in California. In contradistinction to this the making of even 25,000 volt underground cables requires the greatest care and involves constant electrical and chemical research not to mention the attention which must be given to the technique of actual manufacturing and testing before shipment.

It is a curious fact that the insulation for these cables is made out of old ropes and refuse from oil refining. To be more specific it is a rather heavy Manila rope paper wrapped tightly around the copper conductor in strips or "tapes" and saturated with heavy mineral oil that is worthless for ordinary uses.

The character of the paper used is the subject of much attention. It must be strong enough so that it will not tear when wrapped around the copper conductor with adequate tightness or when the finished cable is bent as during the process of reeling or unreeling, or when being pulled into underground conduit. Furthermore, it must be capable of absorbing the proper amount of oil, or "compound" as it is generally spoken of, not only between the fibres of the paper but also within the fibres themselves. It must be free from injurious impurities and have the necessary electrical characteristics such as low capacity, high dielectric strength and low dielectric loss. Paper suitable for a certain voltage may not be suitable for a higher voltage. It must also be capable of withstanding a high degree of heat without charring or "carbonizing," as the cables become hot when carrying a heavy load. All this must be determined before the paper is used for every roll received from the mills because it seems to be very difficult to make it of uniform quality and there are continual variations of one kind or another.



It will be seen that with this shape of stranded conductor the inner wires are larger than the outer ones. Usually the strands are crushed together more than here appears. Note also the paper or jute fillers for taking up the space between the insulated conductors

Cross-section of sector cable

It is the same story with the impregnating compound. The material used is principally petrolatum—a product of the refining of crude oil but the degree of refinement and the method of refining employed are of great importance. Not only is the insulating quality of the compound itself affected thereby but also the amount of it which can be absorbed by the paper. Furthermore certain kinds of paper and certain kinds of compound go best together and the problem is to find the combination which will give the best results for any specified set of operating conditions. These petrolatum compounds as well as the paper vary a great deal from time to time even when there is no apparent reason why there should be any difference. Consequently these variations also have to be carefully ascertained by continual laboratory tests. Five tests on the paper, four on the oil and three on samples of impregnated paper made unremittingly, are the least number which will suffice to ensure good quality. At least twice as many tests have to be made at less frequent intervals.

The heating of cables while transmitting power has been mentioned. This is partly due to the number of amperes of current being carried and can be kept within reasonable limits by providing sufficiently large conductors. There is another cause of heating from the dielectric loss which occurs in the insulation and depends on the voltage and the nature of the insulating material. It is due to the electrical stressing of the insulation and the absorption of a certain amount of power.

The temperature at which a cable can be operated is limited by the amount of heat which the insulation can stand without charring. That is, no cable can be successfully operated continuously above a definite temperature. The heating caused by the current which is flowing is to be expected and is unavoidable but that caused by the dielectric loss in the insulation, which has nothing to do with the current but nevertheless reduces the number of amperes which can be carried, can be controlled to a considerable extent. The "dielectric loss" depends on the electrical properties of the paper and impregnating compound and knowing these from laboratory tests it is possible to predict its magnitude. The insulating strength cannot be predetermined so easily but it is not entirely unpredictable. As regards the highest permissible temperature this is limited by the properties of the oil and the paper. Consequently in designing a cable it is necessary to see that all the desirable characteristics will be attained with the utmost economy both from the standpoint of cost of raw materials and the facility with which they can be put through the manufacturing processes.

Having these requirements in mind let us now see how the cables are actually made. In the first place

there are two kinds of high tension cables—single conductor and triple conductor. Commercial transmission circuits are almost universally three phase and require three conductors. The three conductors may be twisted together and be placed within a common lead sheath so as to take up only one duct in an underground conduit line. This has very definite electrical advantages as the magnetic fields surrounding each current carrying conductor are neutralized by their close proximity. But for very high voltages, say 45,000 between conductors, the insulation has to be so thick that even if the proper manufacturing machinery were available and if the cables would not be too stiff to handle, it would still be impossible to group the three conductors under one sheath because the diameter would be so large that there is no conduit line in existence with big enough ducts to receive them. Consequently for voltages above 33,000 single-conductor cables are used.

The conductors themselves are of stranded copper. In three-conductor cables they are generally sector shaped, as shown in the drawing, for it is possible to have a smaller diameter in this way. With single conductor cables the conductors are, naturally, round. The sizes of the conductor of course vary depending on the amount of current to be carried but 350,000 circular mils is used more frequently than any other for three conductor cables and it is about the largest size practicable for very high voltages because taken together with the thick insulation required the final diameter will be the maximum which will go into existing duct lines.

The stranding operation for round and sector conductors is carried out by different machines but they both follow the same principles. Take for instance a 350,000 circular mil round conductor. This is made up of thirty seven No. 9 A. W. G. soft copper wires that is three layers wound in reverse directions around the center wire. The stranding machine is very long and consists of sections which revolve in opposite directions. The proper number of coils of wire for each layer is mounted in each respective section of this machine. There are six for the first layer, twelve for the second layer and eighteen for the third. The six wires or strands are twisted around the center strand, then the twelve wires over it in the opposite direction by the second section of the machine and the third layer is formed by winding the eighteen strands over this with the direction of winding again reversed. This is known to the cable manufacturer as concentric stranding.

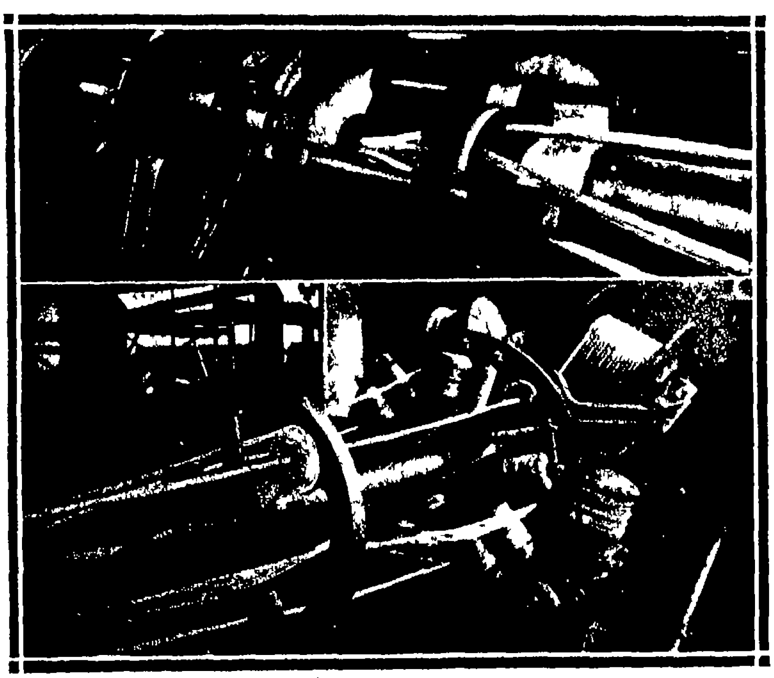
The sector stranding machine shown on p. 324 also consists of parts revolving in opposite directions and in which coils of wire are mounted but in this case the strands in different layers are of different sizes, as the drawing indicates. This is simply because it is better for mechanical reasons to have the inner strands larger than the outer. That is, they shape up better and retain the sector form more securely than if they were all the same size.

The application of the paper insulation is by means of a rather simple machine which we show, but as in almost any manufacturing operation is accomplished with the help of a good deal of technique acquired through much practical experience. As shown in the photo, the conductor passes through a long machine and as it does so the rolls of narrow paper tape revolve and wind the insulation about it. A certain number of tapes are usually wound on in one direction and are then reversed. As many as fifty layers can be applied at one passage through the machine sometimes more if the machine is very large and if a greater thickness of insulation is required it will have to go through again. As the paper generally used is five thousandths of an inch thick, one passage through the machine means one-quarter inch of insulation which is enough for about 20,000 volts. For very high voltages it may be necessary to run through the machine three or four times. The technique comes in in winding on the paper with sufficient tension to exclude air spaces between successive layers without tearing it. Another fine point is to have the spiral of each single tape with the specified uniform overlapping.

After the copper conductors have been covered with the required thickness of paper they are taken to the cabling machine if they are to be made into a three conductor cable. This is where they are twisted together as shown below. It works on the same principle as a simplified stranding machine where there

The press through which the cable passes, after impregnation to receive its coating of lead. Fed in at the back, it emerges at the front with the sheathing applied

is only one layer. Three large reels of insulated conductors are mounted on the revolving part of the machine together with spools of jute or paper strips called fillers which are fed into the spaces between the conductors as they pass through the die, thus giving a solid round cross section to the assembled cable. The twisting of the conductors is accomplished by the turning of the machine. Here again the question of technique is encountered in the necessity of so operating the machine that the points of the sectors will actually always point toward the center. After passing through the die at the end of the machine and as a part of the same operation the assembled conductors are given just as on the insulating machine one or two windings of paper tape to hold them in place. This is the beginning of the "belt" or jacket insulation which may be completed at this point but is sometimes finished on another machine just as already described for the individual conductors.



Below: The reels each carrying a single insulated conductor and the spools of filler in place on the machine. *Above*: Cables and filler converging into the die at the extreme left just beyond which the first layers of the belt are being applied

The cabling machine, which twists the three conductors together, with the "fillers" for taking up the spaces between which would otherwise be void

The mention of the belt insulation brings up a subject which we have not yet considered. Each conductor has a certain thickness of paper around it so that the effective thickness between any two is twice that amount. This of course is designed to be adequate for the difference in voltage between conductors. But the amount of insulation between a conductor and the lead sheath of the cable or ground is only that around the individual conductor and as the voltage to ground is more than half the voltage between conductors it is necessary to provide additional insulation. That is the function of the belt common to all of the conductors. Of course an equivalent thickness of paper could be wrapped around each conductor but that would increase the diameter of the cable and use up much more paper and consequently more impregnating material—that is the cable would cost more to make and would also require larger diameter therefore expensive conduits. In fact where cables are to be pulled into old conduit lines this question of keeping down the diameter is vital.

Of course with single conductor cables the "cabling" and "belt" operations are eliminated.

The cable is now ready for the impregnating department but before actual impregnation is begun certain preliminary steps are necessary. It must first be thoroughly dried. Even the driest appearing paper retains a surprising amount of moisture which if not removed very seriously diminishes its insulation strength. Dry looking paper contains according to careful laboratory tests about 4 to 5 per cent of moisture and ordinary paper as much as 7 or 8 per cent. Consequently the cable on the reel as it comes from the insulating department and weighing perhaps five tons is placed in a hot air oven where it is left for several days. This long continued heating called preheating under conditions where the air in the oven is kept dry removes most of the moisture.

The cable still on its reel is then moved into the impregnating tank shown on p. 324 where the heating is continued for some time longer in vacuo. This removes whatever moisture remains along with the air from even the innermost strands of the conductors as well as from the tuberous fibers of the paper. The duration of preheating and heating in vacuo have been the subject of a great deal of experimentation as a result of which sufficient data have been obtained to determine the proper periods for both treatments for the different kinds of paper, thickness of insulation, etc.

The impregnating compound is introduced into the tank while the cable is still hot and while the vacuum is maintained. After giving the compound an opportunity to soak into the insulation, a matter of from 12 to 30 hours, a high pressure is applied to drive it against capillary force into the channels of the paper fibers. It seems almost incredible that the compound should penetrate through all the layers of paper and even in between the strands of the conductors but it is a fact that this does happen and it is very important that it should do so. As already explained air ionizes under the electrical stresses in high tension cables and causes deterioration of the insulation so that it must be entirely removed and kept out. The only way to do this is to fill completely every pore and fiber of the paper and every other bit of space between layers of paper and between copper strands as well as all other unavoidable minute voids with compound.

The application of the lead sheath is the last step in the manufacturing process. The cable is taken directly from the impregnating tanks to the lead press. It is important that the oil should not be allowed to drain out at this stage.

The lead press, although a machine of great power operated by hydraulic pressure, is not at all complicated. Pigs of lead are placed in a tank to one side of the press where they are melted but not heated more than enough to allow the lead to flow into a large cylinder where it cools down to a plastic state. Just below the cylinder as shown above is a sort of chamber into the back of which the cable enters through a closely fitting gland and out of which it emerges in

(Continued on page 367)

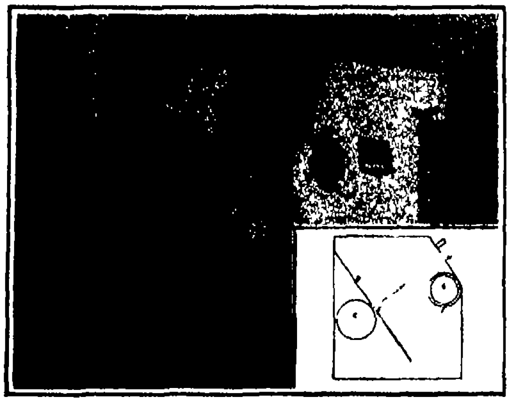
For Faster Seeing

Tests that Show How Better Lighting Makes Us See Faster as Well as Better

By M Luckiesh

Director Nela Park Laboratory of Applied Science

SEEING an object involves time intensity of light character of lighting and many other factors Therefore in our industrious lives where *seeing* is linked with *doing* the question of light is very important It was long ago recognized that improper lighting lowered production, increased spoilage, and decreased safety but not much consideration has been given to the influence of intensity of light That this is a factor is easily determined but how much of a factor is a matter for careful and tedious research Everyone has had the experience of reading when twilight was falling A careful observer would have noted that it became necessary to hold the printed page closer to the eyes as the intensity of light diminished and that the reading became *slower and less certain* But this condition obtains at very low intensities Nevertheless other factors such as the ever present time element in seeing suggest the possibility that even at higher levels intensity of illumination plays a part in any act depending upon vision Furthermore light is enlivening and perhaps we may react more quickly under higher intensities than under lower illuminations



C is a drum containing the printed matter which passes under the aperture *E* *D* is a white or gray screen *G* an opal glass cylinder containing a lamp *F* a screen The light can be varied as desired The head rests at *A* and the eyes see the printed matter at *H*

The apparatus for the speed of reading test, shown diagrammatically and in use

In order to convince ourselves that intensity of illumination plays a prominent part in what may be termed the speed of seeing it is only necessary to provide a moving test-object containing various sizes of type and change the intensity of illumination C H Stickney devised a striking experiment shown in the lower picture The drum, containing letters of various sizes is placed on the turn table of a modern phonograph When it is illuminated to a low intensity we can see only the larger letters at a certain speed but on suddenly illuminating it to a much higher intensity the ease of recognizing the smaller letters and even the large ones is very apparent This strikingly illustrates the influence of intensity of illumination on the speed of vision but gives little idea of the magnitude of the effect

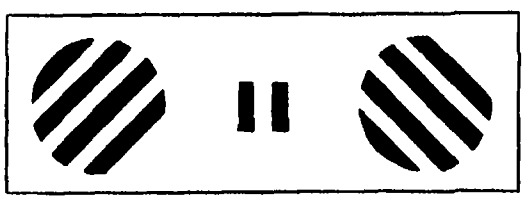
In order to determine the magnitude a number of investigations were begun in Nela Research Laboratories The writer and his colleagues chose first the very common process of reading After considerable experimentation an Old English type was chosen as best suited for the purpose Owing to its complicated letters and to a lack of familiarity with such type the reader must scan all words more carefully than in the case of common type This is a desirable feature A belt of this printed matter was driven by a carefully governed mechanism (upper photograph and drawing) having a direct reading speedometer attached The printed matter passed underneath a slit wide enough so that several lines were visible The observer controlled the speed of the mechanism so that he could have the lines of reading matter pass at the maximum speed for which he could read aloud accurately The intensity of illumination could be varied within wide limits

The result of tests on many observers show conclusively that reading can be done faster and faster as the intensity of illumination is increased There is evidence that the speed of reading continues to increase as the intensity of illumination is increased far beyond any intensities of artificial light now in use The results for reading black print on both white paper (reflection factor 80 per cent) and gray paper (reflection-factor 22 per cent) are as follow

Illumination in foot candles	2	4	8	16	24
Relative speed of reading black print on					
white paper	100	111	121	128	131
gray paper	100	125	160	188	204

The black print on white paper represents usual reading matter, however much of our seeing is a matter of distinguishing lesser contrasts hence the test involving black print on gray paper Here the increase is very marked

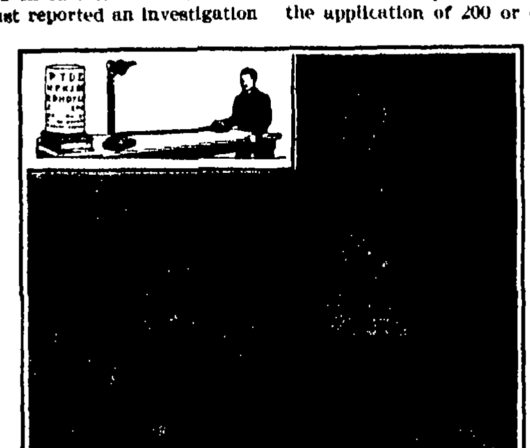
Dr P W Cobb is conducting investigations designed to be more analytical Up to the present time he has used parallel black and white lines as a test object as illustrated In some of his experiments he has introduced confusion patterns respectively before and after the presentation of the test-object These investigations are too complicated for a detailed account here Dr Cobb found an increase in speed of recognition as the intensity of illumination was increased from one to 100 foot-candles with no indication that the increase would not continue for even higher levels of illumination When the illumination intensity was increased from 5 to 20 foot candles for example the speed of recognition of the test object appearing out of a clear field increased over 100 per cent Over the same range the speed was increased about 75 per cent when the test object was preceded and followed by confusion patterns The latter case approximates the condition of a continuous visual process such as reading Such work as Dr Cobb is doing may eventually make it possible to appraise the increase in production likely to result from a proposed lighting installation



These three patterns were presented in the order indicated the first one remaining on the screen three times as long as the second while the third was left on at the end of the test The purpose is to measure the interval necessary for recognition of the presence of the intermediate object It is found that this interval is longer when the confusion pre-exposure and post-exposure objects are used with it, than when it is used alone

Another test for quickness of seeing

Now let us consider tests in factories D P Hess and Ward Harrison have just reported an investigation in the inspection department of a well known factory They found an increase of 12 per cent in the production (number of pieces inspected of 44 workers) as the illumination intensity was increased from 5 to 20 foot-candles The increased cost of lighting was equivalent to only 2 5 per cent of the payroll of the workers involved so that there was a gain in production of approximately 10 per cent without additional cost W A Durgin a few years ago reported various increases in different departments of a number of factories In his cases usually the system of lighting was greatly improved at the same time that the intensity of illumination was increased His increases in production varied from 8 to 100 per cent depending upon the nature of the work and the change in character and intensity of illumination Recently a large factory reported an increase of 10 per cent in production in the daytime resulting from cleaning the windows.



Apparatus, and manner of use, in a simple test for showing the influence of light intensity upon the speed of vision

In all cases the cost of better lighting is such a small part of the value of the increased production that the better lighting appears to be eminently worth while economically

Furthermore, these higher intensities and better lighting make work places safer and more cheerful. Much work remains to be done in order to establish accurate figures of the economics of better lighting in various activities but the data already available indicate that the entire lighting bill of this country would be more than paid for by the increase in production in the industries In other words if factories were lighted to higher standards the entire lighting of this country could be accomplished at a net cost of less than nothing

Ammonia from the Air

IN 1899 Sir William Crookes pointed out that the world's food supplies are dependent upon a supply of nitrogenous fertilizers to the soil Each crop takes so much out of the soil that unless this essential material is replaced the yield per acre steadily drops There is an inexhaustible store of nitrogen in the air, but nitrogen as such is one of the most inert of materials It is only when it has been made to combine with other elements such for example as hydrogen that it becomes available as plant food The problem in this case consists in taking from the two abundant sources, air and water the constituent nitrogen and hydrogen and combining them in the form of a new substance, ammonia

At the beginning of the present century there was no known method for any such fixation of nitrogen but as the result of applying pure research there are already many industrial methods of fixing nitrogen in actual operation on a very large scale This great result has been achieved in the important instance of the synthesis of ammonia

Thermodynamics supplies two of the most fundamental laws of science The first law is that we can not get perpetual motion we can not get work for nothing The second law is that all spontaneous proceeds (and these only) may be utilized to give work

On applying these laws to chemical reactions Willard Gibbs followed by van t Hoff and others, obtained a mathematical relationship called the Mass Law This law revealed the fact that it was within the power of the chemist to make the reaction $3H_2$ plus $N_2 \rightleftharpoons 2NH_3$ go in whichever direction desired since the effects of changes in such factors as pressure and temperature could be predicted The first problem was to find the most suitable equilibrium This was done when it was found that the production of ammonia is increased by the application of 200 or even 1000 atmospheres pressure The next problem to be solved was the regulation of the temperature to give the most satisfactory yield The ammonia must be produced at a practical rate and to bring this about substances termed "catalyzers' are employed to hasten the reaction and in addition materials called "promoters' have been discovered which increase the catalytic efficiency

By applying all these principles the Germans have already succeeded in producing ammonia at the rate of over 1000 tons a day Thus from the knowledge obtained by pure theoretical and laboratory research, there has been achieved a result which is vital to the existence of the white population of the world.—*Abstract from address by Professor J W McBain.*

The casing of a Kaplan turbine showing the extreme simplicity of the guide vanes. The rotor of a Kaplan machine of 1000 horsepower and the tiny experimental model (below). A modern Francis turbine showing the extreme weight of this part of the machine

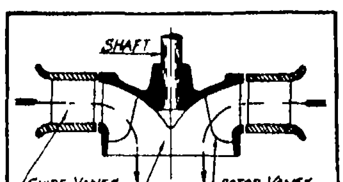
New water turbine designed by Prof. Kaplan of Czecho-Slovakia, showing how it contrasts in fundamental structure with the existing standards

Speeding Up the Water Turbine

By C. A. Oldroyd

MORE power—more speed—at less cost along these lines in one way or another, all modern power generators have been developed.

The slow steam engine gave way to the high speed steam turbine of immense power, the huge water wheel was superseded by the Francis turbine and here development seemed to stop. With the steam turbine the high speed dynamo was introduced and engineers longed for a water turbine of corresponding speed.



Section through a Francis turbine

After lengthy research Prof. Kaplan of Brunn University, Czecho-Slovakia, has now succeeded in designing a high speed water turbine, a machine of extreme simplicity.

In the Francis turbine, the water enters the rotor through a set of guide vanes surrounding the rotor. In passing through the latter the water transmits its energy to the rotor. Such turbines have very large and correspondingly heavy moving parts weighing many tons.

In the Kaplan turbine the guide vanes lie at right angles to the rotor blades. The heavy rotor is here reduced to a kind of ship's propeller having either two or four blades.

Through such a turbine the water can pass at very high speed so that the diameter of the rotor can be reduced to one half that of a similar Francis turbine. Chunks of ice, timber fragments, etc., which might wreck a Francis turbine, can easily pass through a Kaplan turbine.

As a general rule the Kaplan turbine rotates four times as fast as a Francis turbine under similar conditions so that the high speed dynamo can be directly coupled to the rotor and belt and gear transmissions are done away with.

From the photograph showing the casing and guide vanes for a 1000 horsepower turbine, their extreme simplicity is evident. The Kaplan turbine has a further advantage, it shows no falling off in efficiency when running at less than full power. The rotor blades are adjustable, their inclination can be varied according to the load. The inclination is controlled by the large lever shown above the casing.

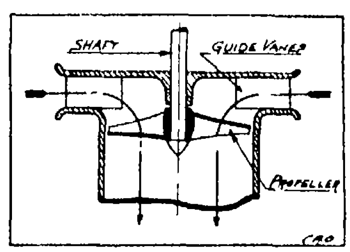
The old "umbrella" type of dynamo driven by a Francis turbine impressed the laymen very much, but gave anxious hours to the station engineers. Now it will be superseded by fast turbines of the Kaplan type, with lightly loaded bearings and compact rotors. Standard high speed dynamos, as used with steam turbines, will be employed, and in general appearance, such a plant will greatly resemble a steam turbine installation.

A Movie "Mayflower" of Steel

A REPRODUCTION of the "Mayflower" has been set up in Charles Ray studios in Hollywood, California and was used in the filming of "The Courtship of Miles Standish." This vessel is as nearly an exact copy of the original as the builders could make it except in one important respect. The hull was entirely of steel. Her length was 102 feet, her ample beam was 24 feet and her molded depth was 14 feet. The copied hull was mounted by means of a ball and socket joint on the top of a heavy concrete column in such a manner that the director of the film could have it rolled in any way he desired. This work was performed by steam generated by two 25 horsepower boilers, and whether it was necessary to produce a gentle ground swell, a heavy beating-to-windward pitch or a hurricane or even to throw the Mayflower on her beam ends, the result was accomplished the instant the director megaphoned the signal.

To carry the illusion further a wall and bed of concrete large enough to hold an acre of water was constructed. This miniature sea when agitated gave a very realistic representation of the Atlantic Ocean. The imitation was assisted by many sorts of ingenious water towers or breakaways by means of which hundreds of tons of water was hurled against the sides and over the decks of the little Pilgrim ship quite after the fashion in which the ocean must have handled her prototype in 1620.

If the shades of John Alden and Miles Standish were hovering about we wonder what would have been their perplexed opinion of the performance.



Section through a Kaplan turbine

The left-hand platform carries the dull tools into the furnace; the other, consisting of a series of small water filled buckets, brings them back to the operator after a session with the hammering and grinding machines in the right background

The chisel sharpening machine that keeps a big granite cutting shop supplied with keen edged tools

Sharpening a Thousand Chisels a Day

By Francis A. Westbrook

IN those mills known as "granite cutting plants," where blocks of granite are brought in from the quarries to be made suitable for building and monumental purposes, it is necessary to use a great many small cutting tools which require frequent sharpening to insure a good quality of workmanship and efficient production.

In a large cutting plant it is necessary to sharpen something like 1000 of these tools every day so that unless proper means are employed to keep down the cost this might very easily be a serious item of overhead expense. Very effective means have, however, been found in the adoption of the sharpening machine associated with the power hammer and carborundum wheel as shown in the accompanying illustration. The arrangement is simply an adaptation of the moving platform idea with the other machines located with a view to maximum efficiency.

The sharpening machine consists of an oil burning furnace and two small moving platforms—one to carry the dull tools into the furnace and one to bring those which have been sharpened back again. The oil furnace operated by compressed air under 95 pounds pressure, power hammer and carborundum wheel are shown in the background of the picture. The left hand moving platform or chain which is flat carries the tools into the furnace where they are heated. A man sitting in front of the power hammer with his back toward the observer of the picture and with the carborundum wheel at his right hand takes the tools out of the furnace, hammers them into shape, grinds them while still hot, and then drops them back upon the right hand chain.

This chain consists of a series of buckets which are at first filled with brine to temper the chisels when they are dropped in hot. As the chain moves along and away from the operator the brine flows out and cool water flows in so that by the time they have reached the end of the chain in the foreground they are cool. The chain then drops them into a receptacle standing on the floor, which carries them back into service.

Where Water Pumps Itself

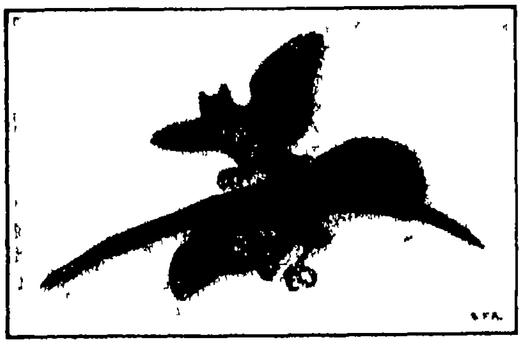
AN Oregon mine well up in the mountains has taken advantage of its location to pump the water out of its galleries though its mean depth is about 600 feet without any cost save that of installation. The water literally pumps itself. The secret lies in the fact that the mine location is such as to make possible the construction of a power flume, carrying the water off into one of the nearby valleys and giving a 1500-foot head. Once the thing is started it runs on indefinitely, the power from the flume being ample to run the mine pump.

Animal Animosities

Fact and Fancy Regarding the "Deadly Hatreds" of Wild Species

By S F Aaron

Drawings by the Author



The boldest of all birds attacking a red shouldered buzzard when the latter sought a roosting place uncomfortably close to the nest of the former

The standing feud between the screech owl and the larger hawks

THE nature writers some of them unfortunately fakers have derived much sensation from the imagined inclination of wild animals to engage in deadly struggles. Most readers enjoy a fight in the telling and especially so if the moral responsibility for the lack of humanity happens to be wanting.

Pitched battles for the mere sake of fighting or long continued contests for any cause are rare or may never occur among the highly organized creatures. Despite the continual struggle for existence between those that prey on are preyed upon and the rivalries during the mating seasons the inhabitants of the wilds are generally prone to avoid hostilities that can gain them nothing but wounds. Most creatures fully comprehend their own powers and those of others capable of inflicting injury and they are unwilling to risk possible hurt or even engage in violent effort to little purpose. Thus the puma and the bears though undoubtedly possessing a hatred for each other due to their seeking similar game hold a truce rarely if ever broken the stories to the contrary being pure invention. The bobcat and the Canada lynx in those regions where their habitats merge fully respect each other even when one is hungry and the other has made a kill and that these most grouchy carnivora avoiding their own kind except during the breeding urge and at odds with all other creatures keep from personal encounters is sufficient evidence of a common inclination.

The flies generally begin these fights vainly trying to pierce the beetle's chitinous coat of mail then the beetle seizes the marauder's leg and the latter usually escapes only by sacrificing that member

Robber fly and tiger beetle

The fighting of males over mistresses of a common choice is a usual thing among the mammals and birds, but these are individual affairs upon the spur of the moment and they rarely mean more than a brief scrap one contestant either quickly getting the worst of it or the two backing off with mutual respect and each going its way. However powerful and possibly bloodthirsty the opponents they are commonly too sensitive to injury and pain to continue receiving it. This is also the case among domestic animals except when they have been especially bred to overcome fear and hurt as the bull dog and the game-cock.

With some species as the flocking migratory birds these rivalries are forgotten and the former scrappers mix amicably with each other. Among the polygamous continually breeding species of warm countries or that originated there as the domestic fowl and the peacock these rivalries continue and thus also with the herding mammals where the weaker males are perpetually driven off by those stronger.

Feuds between different species one or both of which threaten the safety of the other's young are not uncommon and this is the chief cause of such hatreds as exist between the wildcat and the wolf the mink and the fox the raccoon and the weasels. The enmity that the crow displays toward the hawks is an example and it is shown also by the suspicion with which all herbivora regard members of the larger felines and canines. The deer and the hog have a similar but probably a less purposeful enmity for all snakes. The well known animosity of the kingbird toward nearly all birds which it must regard as potential egg stealers, the similar warfare declared by the purple martin against hawks and crows, the battles between robins and thieving grackles and the suspicions directed toward the jay by all small birds are merely developments of self preservation.

The feud between the sparrow falcon and its much larger relatives the red tailed and red shouldered buzzards is not so easily comprehended, for the big hawks cannot readily reach the young falcons in the narrow tree cavities and where the nest is always guarded. It may be mere suspicion and the knowledge on the little falcon's part that the buzzards might enjoy fat young falcon. The animosity shown is nevertheless out of proportion to its cause, the falcon giving evidence of a wing power equal to that of any bird of its size, swoops from far above upon the back of its enemy, sometimes striking and tearing the feathers away but rarely if ever disabling the larger bird so that its retreat is checked.

Among the reptiles certain feuds exist that are more difficult to explain such is the king snake's desire to destroy all poisonous and some non venomous species larger and seemingly more powerful than itself. Nor is it understood why the rattlesnake shows a readiness to inflict its horribly aggressive defense upon dogs cats larger birds and humans and regards with indifference the nearness of horses and cattle unless trodden upon. Its enmity for the hog is natural enough. It may seem strange also considering the small intelligence with which we credit reptiles in general, that the skunk and some snakes readily distinguish herbivorous from carnivorous animals fleeing from the latter and approaching deer and cattle to feed upon the flies that they attract.

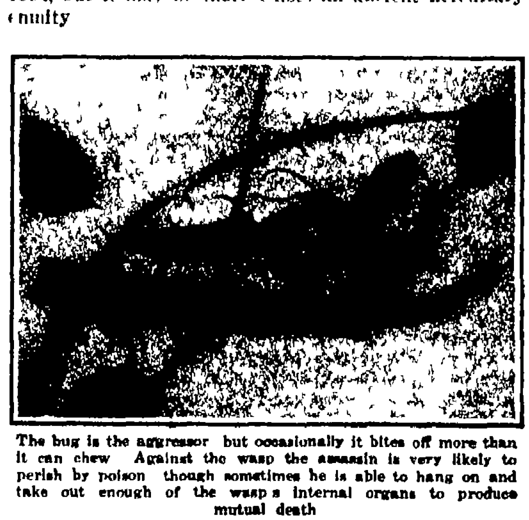
It is among the insects and their allies that specific animosities are most bitterly expressed though many of the more highly developed six legged banditti know their peers and decline to mix with them in the struggle for existence. Others exceed the mammals in daring and pluck. The social hymenoptera with their stings as weapons for the defense of the colony habitations are examples of the highest development in the expression of that which may be called nothing less than patriotism. The animosities these valiant little creatures show toward any enemy that may encroach upon the paper nest or the hive are endless. It may appear strange that the solitary bees and wasps do not show this same spirit generally in defense of their nests but this is explained by the fact that the larger creatures give the diggers and mud daubers little concern and it may be assumed that the encroachment of moles or shrews or earth boring beetles would be resented. A digger wasp that only preys upon spiders has been seen to attack and drive away a large grasshopper from the vicinity of the burrow.

Whether fighting in defense of the nest or because of the desire for food the arthropods present the most daring and valiant warriors and the battles that result are the most prolonged and vigorous. Often the size and prowess of the attacked cut no figure in the determination of the attackers. Thus the robber flies, the assassin bugs the tiger beetles and certain spiders eagerly seize upon creatures far larger and more powerful than themselves and those also capable of inflicting injury or death. The wheel back bug the cone-nose and the flat stink bug or any one of their assassinating relatives, commonly attack whatever may come within reach of their deliberate, but no less sure grasp and the puncturing power of their sword like probosces. The intended victim may be endowed with sting or severing jaws, but the assassins do not hesitate and occasionally a yellow jacket or a polistes wasp may be seen with its vitals pierced, effectively applying its sting to the bug, one dying of enforced anaemia the other of injected venom.

Swifter of wing than most predacious hexapods, the robber fly represents among insects the position of the hawk among birds, its attacks are often made in mid air. It does not hesitate to pounce upon wasps or bees, generally seizing the victim from behind with its long, strong legs and in such a manner that it cannot be reached by the sting. Occasionally it risks too much, as when attacking the digger wasps the extended and flexible abdominal petiole permits the sting to pierce the fly. The big black robber fly also sometimes clashes with the queen of hornets the beautiful big sand hill digger and there is either an instant separation of the contestants or the robber drops lifeless to the ground before its stiletto-like proboscis can stab its opponent. In such cases, however all the animosity is on the part of the robber fly.

Tiger beetles also are willing fighters, often when they do not seem to gain food thereby though this may result from error in picking the victim which may make a victim of them. The Cicindela does not hesitate to come to grips with an assassin bug the awful odor of the latter which effectively warns away the vertebrate insectivora having no terrors for the beetle. This is an affair that any lover of a good scrap will delight to witness crushing jaws and a coat of mail against a piercing sword and if there is not too much difference in size and strength the more agile and better protected beetle always wins by pinching off the proboscis, or the entire head of its adversary and then feeding upon it. In like manner the tiger beetle's armor serves a needed purpose when it attacks or is attacked by a robber fly and this occurs not unfrequently. The beetle can seize only a leg of the fly and the robber cannot thrust its dagger into the beetle but both are exceedingly persistent rolling over and over in the effort to gain the fight the robber's wings keeping it generally on top and eventually aiding it to get away though often with the loss of a leg.

A very certain animosity of long standing is evident by the contests between colonies of ants notably the big blacks and the equally large red and brown species both common in our woodlands and fields. This is war with mob like management no drill nor generalship exhibited, but none the less a combination of actions and a determination that is worthy of patriotic emulation on the part of humans. For defeat only comes by total annihilation. Let the two colonies of these ancient feudists but chance to be established within ranging distance of each other and war is certain one tribe as though at a signal making an onslaught upon the other perhaps coveting its stores of food, but it may be there exists an ancient hereditary enmity.



The bug is the aggressor but occasionally it bites off more than it can chew. Against the wasp the assassin is very likely to perish by poison though sometimes he is able to hang on and take out enough of the wasp's internal organs to produce mutual death

Assassin bug vs. mud-dauber wasp

Rotary Car-Dumping on a Giant Scale

DUMPING a fifty-ton car of coal in 1 minute 10 seconds, with only one man, unskilled and a 85-horsepower motor—that is the feat being performed daily by a recent installation at St Louis With only the first unit of the Cahokia power plant completed at the present time the coal consumption averages but eight cars a day Under the burden of eight cars a day the continued operation of the dumper seldom exceeds twenty minutes The completion of additional units will, of course, place a greater burden upon the dumper but it is interesting to know that with this minimum load the contractors feel the dumper pays for itself in time and labor saved They contrast the rotary dump method with the bottom-dump method which usually requires the labor of two men for thirty minutes to unload one complete car of coal

From the mechanical standpoint the mechanism as is the case with any rotary type of car dumper has three distinct functions to perform viz the rotation of the car through an angle which will permit the discharge of the material support of the car on its tipping side, and the clamping of the car at the top In spite of this multiple and seemingly complicated action, the operator in this case, has but one controller handle to operate This controller is of the drum type similar in design to a street-car controller And while it provides speed control its primary function is the starting of the rotating motor All other operations are cared for automatically by limit switches

With the car in the normal position on the dumper the controller handle is in the neutral position To begin the cycle of operations the operator moves the controller handle into the extreme forward position Rotation of dumper and movement of the transfer table start immediately Upon rotating ten degrees a projection (built on the side of one of the roller rings) operates a track limit switch which in turn, starts the top clamp motor This motor pulls the four top clamps downward simultaneously, until all four clamps have become firmly seated upon the top of the car and have exerted a predetermined pull on the operating cables When this predetermined pull has been reached it displaces an idler, operating a load switch cutting off the motor and setting a high torque brake

With the car then firmly held to its dumping side and clamped at the top, the dumper continues to rotate until the rotating motor is automatically stopped by limit switches at the end of the rotating movement Up to this time all the operator has done is to move his controller handle from the neutral to forward position

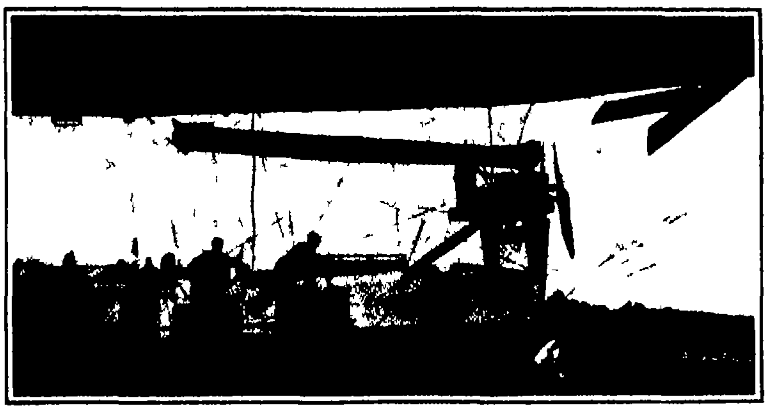
He now moves his controller handle through the neutral position and into the extreme reverse position This reverses the direction of the rotating motor and the dumper returns to its normal position On the return, when the dumper is within approximately ten degrees of its initial position, the top-clamp motor limit switch is tripped, which automatically reverses the direction of this motor and counterweights raise the top clamps to their initial position When the top clamps have reached their uppermost position the clamping motor is cut out by a limit switch operated by one of the clamps. The rotating motor is also stopped on its return movement by a limit switch and the rails are held in correct alinement by a solenoid brake

The outstanding feature of this car dumper is its fool proof construction and its simplicity of operation It is impossible for the operator to perform the cycle in any other than the correct way

Two views of the gigantic jaws of the rotary car dump at Cahokia (St Louis) power plant Twenty minutes' operation of the dump takes care of a day's fuel—and in this brief interval the big machine more than pays for itself

Determining the Fire Hazards in a Forest

THE principle of the evaporimeter is applied in an interesting way in the inner-cell evaporimeter invented by Mr C G Bates Director of the Fremont Forest Experiment Station near Manitou, Colorado In this special form of evaporimeter a round wick leads up from a reservoir holding about a pint of water and connects with a flat wick spread over a disk about 4½ inches in diameter The flat wick represents the surface of a leaf The disk on which the flat wick rests is perforated with a number of holes which may be considered to represent the stomata of a leaf Evaporation can therefore take place on the under side of the wick The metal cover above and in contact with the wick is blackened to absorb sunlight The instrument is placed in an exposed position so that the wind can blow over it The conditions of evaporation from vegetation are, therefore approached very closely



Airship equipped with condenser for recovering water from the exhaust gases and thus compensating for the weight of the fuel burned

It has been determined that when water evaporates from the evaporimeter which we have just described at the rate of twenty grams in twenty four hours the conditions for forest fires are approaching the danger line This is a tentative standard subject to correction as further data are accumulated Other conditions are taken account of in determining fire hazard such as the green or dry character of grass and weeds the number of conifers in the forests and so forth In October the hazard is greater than in June with the same rate of evaporation It sometimes happens that the evaporimeter absorbs a slight amount of moisture and actually becomes heavier At such a time there is no danger of fire

The particular evaporimeter in use at the Fremont Forest Experiment Station is the *standard* with which others used elsewhere are compared Others are made as nearly like this one as possible and calibrated The calibrating is done by placing the standard evaporimeter and those under test on a table which is exposed to the sunlight and rotated slowly and at a uniform rate by a water motor so that the conditions are exactly the same for all the instruments. Each evaporimeter is carefully weighed at the beginning and at the end of the test and the rate of evaporation compared In making the comparison the ratio is carried to the third decimal place

Assembled and disassembled views of the evaporimeter, which tells the moisture conditions of the forest trees and their susceptibility of the moment to fire

Recovering the Weight from Burnt Fuel

TO maintain the equilibrium of an airship inflated with either helium or hydrogen gas it is necessary at times to valve or in other words permit some of the gas to escape in order to compensate for the weight of fuel consumed by the engines or to overcome the expansion of the gas caused by the heat of the sun s rays

How to compensate for the weight of fuel lost and also to maintain the lifting gas at an even temperature so as to conserve the costly helium which in the future is destined to supplant the dangerous hydrogen gas in lighter than air craft presented a difficult problem for Government engineers Although the experiments were financed and sponsored by the Air Service credit should be given to Bureau of Standard scientists for developing a really successful device

The condenser consists of a series of long slender pipes or tubes 022 inches in wall thickness and one inch in diameter comprising some 800 feet through the inside of which gas is conducted on its way from the exhaust manifolds of the engine to the atmosphere The air, sweeping over the outside of the pipes as the airship is in motion, cools the gases and the condensed water vapor is drawn off from a separator through appropriately located drains The efficiency of the device is such as to produce enough water to weigh approximately the same as the fuel consumed

The apparatus which of necessity had to be built as light as possible in order to permit its use on airships weighs only about 450 pounds, complete is made of aluminum and aluminum alloys and is sufficient to take care of the exhaust from two 150-horsepower engines The efficiency of the apparatus was evidenced by the recent successful trial flights of the Army Airship D 3 at Langley Field Va and the Aberdeen Proving Grounds Md and it is quite likely that same will be installed eventually on all service airships

A Scheme to Salvage Lost Ideas

THE progress of ideas depends much upon cross fertilization. Many ideas never bear adequate fruit because they are held back by present standards of scholarly presentation. We need a more informal and unverified presentation of suggestive ideas in order to speed up the fertilization process. Some scientific journals already approach the idea here suggested but do not, it is thought, officially recognize it.

Among thinkers are those whose minds pursue a thought straight to its conclusion, with no difficulty in concentration and perhaps with some difficulty in supplying illustrative and corroborative material. Opposed to these is the man whose mind strikes a subject like a dum-dum bullet. A dum-dum spreads out at once. It tears a big hole, but it doesn't get very far. The dum-dum mind finds difficulty in finishing what it starts, because the impact starts associations laterally in all directions instead of straight ahead. *It is distracted by* the push and pull from all sides, and perhaps has an unconscious resistance against going ahead. Its results are apt to be bulky but fragmentary, uncorrelated, not clean cut, in extreme cases, incoherent and ineffective.

The dum-dum mind is less likely to produce completed achievements of accepted merit. The "armor piercing" mind however, would frequently fail to get its initial impetus and direction if it were not for some explosive variant idea, originating in this or another mind. Very often such a stimulus comes from the combination of two widely *different and previously* separated elements. It is among such elements that the dum-dum mind is at home. If it is not fetching the metaphor too far, the dum-dum mind is then also like the explosive bullet or the secondary charge in the projectiles which reached Paris from the supergun. It sets in motion new forces, new lines of thought by combining old elements.

To adopt a less crude metaphor: is it not true that many minds secrete valuable ideas faster than they can possibly be worked out in the form which standards of scholarship demand for reputation? Are not such ideas largely lost, like the spores of mushrooms or the myriad spermatozoa? The minds that give them birth are in many cases communicative but shy or isolated. Where they have been willing to give their excursive speculations to the world they have been greatly appreciated even tho greatly criticized. Such, in widely differing ways, were Nietzsche, Pascal, Amiel, Aurelius. Such a contribution, in a sense, is Jung's "Psychology of the Unconscious."

Even where there is some interchange of ideas between scientists of a given field, there is comparatively little cross fertilization between academic departments. In lieu of compulsory continuation courses for all instructors, or super seminars, there should at least be *informal interdepartmental discussion groups in every* college faculty.

May it not be possible to find some common channels through which valuable associations of ideas—flashes and glints which may or may not stand the assay of verification—may be put into currency and made permanently available? This idea is itself an unverified inspiration, advanced for criticism, perhaps for experiment. It comes to us in the first instance from Prof Thomas D. Eliot, of Northwestern University.

It is proposed that the scientific quarterlies introduce *an exchange and discussion department whose editor* would seek for and select from the best commentary material secreted from time to time by readers and associative thinkers.

Furthermore, reviews of other periodicals should include occasional excursions into widely different fields, and might well be included in the same department from time to time.

For such a department the name "Marginalia" is tentatively offered as suggesting the type of idea which a thoughtful reader jots down in his margins. Contributions might be limited in length to one paragraph, might be limited in each issue to one general field but the subjects announced some months in advance, might be made anonymously when desired, in order that no question of scholarship might inhibit the exchange of ideas.

Tests of Natural and Culture Pearls

A SIMPLE optical method of distinguishing the Japanese "culture" pearls from wholly natural pearls is described by Dr F. E. Wright in the Journal of the Washington Academy of Sciences, 1923, vol 13, p 282. In a bead of mother of pearl, such as is always used for the nucleus of the "culture" pearls, the nacreous layers are not concentric to the surface, but are approximately plane, being parallel to the surface of the shell from which the bead was cut. Now normal to this surface *the reflecting power, and consequently also the opacity,* is at a maximum whilst at 90 degrees from this direction (that is, looking along the laminæ) there is a minimum of reflection and of opacity. A "culture" pearl when viewed in a strong reflected light (for example, with the observer's back to the sun) shows at the opposite poles of one diameter a small bright spot due to the light reflected from the laminæ of the enclosed bead of mother of pearl. In a strong beam of transmitted light (arranged in a closed box with lens and mirror, the pearl resting in a circular aperture) the "culture" pearl *shows two positions of maximum opacity*, whilst the natural pearl is the same in all positions. A third method which is applicable also to "culture" pearls containing a real pearl as nucleus, is given by an examination of the walls of the hole drilled through the pearl. The pearl is illuminated by a strong side light and a minute bead melted on the end of a gold wire is inserted in the bore to act as a reflector, which is viewed under the microscope. The behavior is then substantially as in the other tests.

Saving Pulley-Power With Cardboard Discs

SEVERAL years ago, in some experiments conducted with high rotational speeds the attention of the Riverbank Laboratories of Geneva, Ill. was called to the relatively large amount of power required to maintain such speeds. As is well known, the head resistance of the air against a body moving through it is proportional to the square of the speed with which the body moves and consequently the power required is *proportional to the cube* of the speed. This means that doubling the speed of a moving body quadruples the air resistance and calls for eight times the power. The importance of this fact is well recognized in aeronautics. The fact that airplane speeds have now been attained which are practically double the maximum attainable at the close of the war, and this with only a very slight increase of motive power, tells how successful aeronautic engineers have been in reducing the head resistance of aircraft.

This naturally suggests the question of power losses due to air resistance *in flywheels and line shaft pulleys*. Of course anybody who stops to think for a moment realizes that a certain amount of power is wasted in stirring up the air about the revolving spokes of a machine pulley. While the conditions prevailing in the case of a body moving through the air may not hold in the case of a revolving wheel, yet the facts cited above indicate that power losses, due to air resistance, may be considerable. The two practical questions that arise are: first, how much power is thus wasted, and second, how can this waste be prevented by means that will not cost more *than the saving effected*. *The* answer to these questions has been found by actual measurements only within the last year.

One naturally thinks of trying the experiment of running a pulley in the air and in a vacuum and measuring the power required in the two cases. Such a procedure is direct and scientific, but it is a fussy experiment to perform and offers no practicable means of eliminating the waste once its magnitude has been measured. Streamlining the spokes of pulleys is also a possibility, but it is an open question how effective such a method would be in the *actual case*. The method finally employed will appear in the following description of the actual experiment performed at Riverbank Laboratories.

The power expended in producing a rotational motion is given by the well known formula

$$H\ P = \frac{6.2832}{33000} \times R\ P\ M \times T$$

in which T is the torque on the driving shaft. The torque required to drive the pulley was measured by a simple but very effective torque dynamometer, devised for the purpose. For the working out of the details of this instrument, credit is due Mr B. E. Eisenhour of the Riverbank Laboratories. A standard ⅛ h p variable-speed motor was nicely mounted on trunnions so as to be free to turn about the armature shaft. The test pulley was mounted on an extension of this shaft. The *reaction of the load on the motor case tends to turn* this. The force required to balance this reaction was measured upon a sensitive spring balance. The product of this force by the length of the lever arm on which it was applied gives the value of T in the equation for computing the horsepower. The speed was measured with a stop watch and a tachometer applied to the shaft.

A wood pulley with a 6 inch face, 12 inches in diameter, with four flat spokes each 4½ by ⅝ inches and a rim 7/16 inch thick was mounted on the shaft. At a *speed of 1840 r p m the force on the balance at the* end of a 2½ inch lever arm was 3.475 pounds. The computed horsepower expended was 246, a very appreciable fraction of the load which such a pulley might be expected to carry.

Two cardboard discs were then fitted to the two sides of the pulley, thus enclosing the spokes. Under these conditions the force was reduced to 25 pounds, at a speed of 1850 r p m, and the horsepower to 018. The saving thus effected by the simple expedient of enclosing the revolving spokes was 228 horsepower. *The process also materially increases the safety of* such a pulley.

In the following table, the results of a number of similar tests on pulleys of various types run at different speeds are given. These tests were made by Mr J. T. Gibbens, Engineer for the Calumet and Hecla Mine.

Type of Pulley	*Size*	*R P.M*	*Saving in H P with Discs*
Steel 6 arms	24" x 2"	650	00375
Split Wood	12" x 4⅝"	1760	029
Split Wood	12" x 6¼"	300	0007
Split Wood	12" x 6¼"	400	00124
Split Wood	12" x 6¼"	500	00149
Split Wood	12" x 6¼"	600	00222
Split Wood	12" x 6¼"	900	00556
Split Wood	12" x 6¼"	1000	00756
Split Wood	12" x 8"	1000	00372

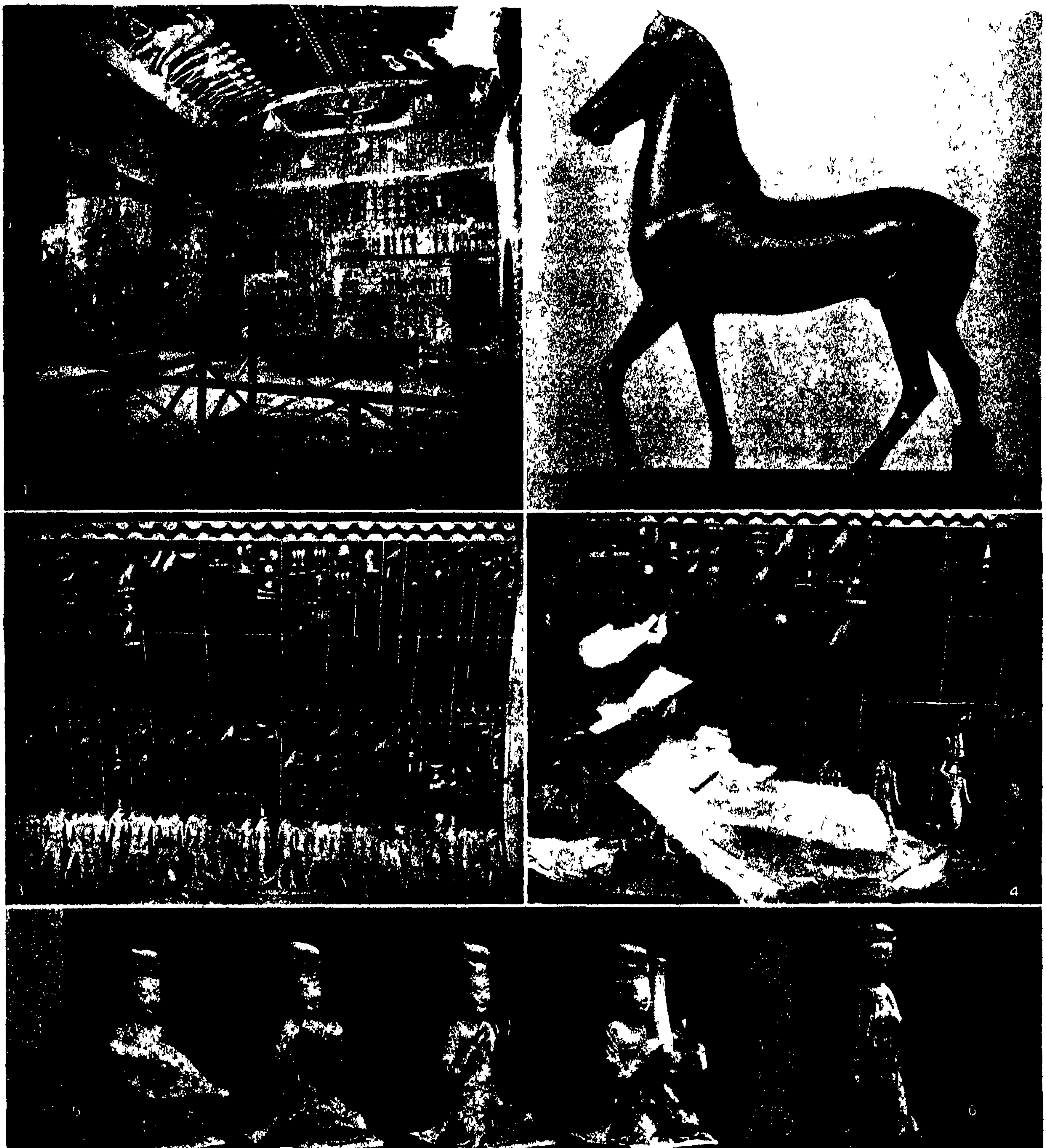
It is to be noted that the power loss increases rapidly with both the speed and the size of the pulley. At first glance, these losses seem negligibly small. However, the operator who cares to apply these figures to his own power costs, taking into account the number of pulleys in an entire plant that are wasting that power throughout the year's operations, will find that this wastage will represent the income from no inconsiderable investment. Thus the total cost at eight cents per horsepower hour of the power loss in the 24 inch steel pulley given above will amount to about a dollar a year. The simple plan suggested of converting the wind throwing pulley into a revolving cylinder will result in a saving of considerably more than it costs.

The Use of Waste for Building Materials

IN a lecture delivered before the Royal Academy of Arts, London, on Wednesday, November 21, Professor A. P. Laurie discussed the manufacture of building materials from such waste materials as blast furnace slag, cinders, clinker, and, in the neighborhood of Edinburgh, burnt shale, the residue from the stills of the oil industry. There are three ways in which these materials can be utilized—for the production of bricks, for the production of cement, and as aggregate mixed with Portland cement or plaster of Paris. The *general method adopted for the production of bricks* is known as the sand lime process. Briefly, this process consists of mixing the aggregate with a certain proportion of lime and water, squeezing it into a brick under a pressure of some two hundred tons to the area of the brick and then steaming under high pressure or in open steaming chambers. Bricks are now being manufactured by this process from sand, blast furnace slag granulated by being run while hot into water, clinker, town refuse, slate dust, and burnt shale.

Cement is being manufactured by two Scottish steel companies from blast furnace slag granulated, mixed with lime, and then raised to a high temperature so as to form a clinker in the same way as ordinary Portland cement was manufactured. This cement, known in Germany as iron cement, can be sold in this condition, or can be finally ground with a mixture of a certain proportion of raw blast furnace slag.

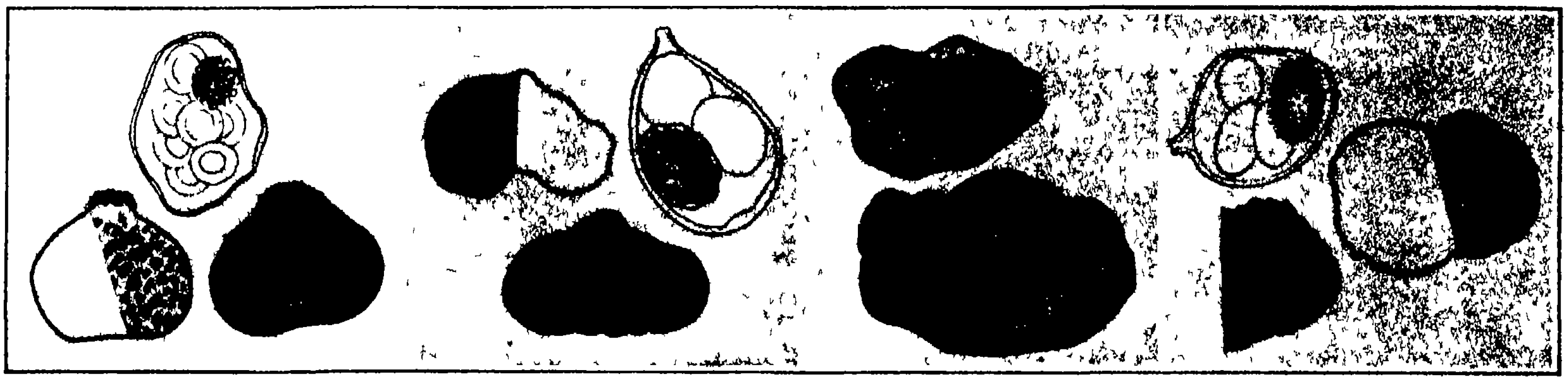
The uses of these materials as an aggregate opens the question of how far it is possible to reduce the content of Portland cement, and at the same time get sufficient strength for building purposes. The objection to the usual building slab made of cement is that, in order to be able to remove it from the machine as soon as made, the content of water has to be kept low and consequently, the crushing strength of the finished slab is also low. Two interesting methods of getting over this difficulty are the Crozite method, in which the cement bricks were sliced off from the bottom of a column of cement and aggregate, and the method in which a heavy compression is put upon the bottom and top of the slab at the moment of completion. The Crozite process is being carried on in America.



Photographs copyright by the Metropolitan Museum of Art

ONE of the most interesting finds outside the Tutankhamon Tomb, the most gorgeous and important Egyptian discovery is the tomb of King Seti I (about 1313-1292 B C) of the XIX dynasty in the famous Valley of the King's Tombs The ceiling in the sepulchral chamber is adorned with a remarkable astronomical chart or list, which is now being studied by astronomers as well as archæologists. View 1 is the hall and views 3 and 4 show star lists. The tomb was excavated by the Metropolitan Museum of Art View 2 is a small Greek bronze horse which is given a place of high honor at the head of the great staircase at the Metropolitan Museum of Art. It is only about 16 inches high but appears almost of heroic size It weighs 26½ pounds It dates from about 480-460 B C. It is a masterpiece of Greek sculpture Views 5 and 6 are Chinese tomb figures, the long group being girl musicians and the single figure is a dancer The musicians are made of slightly fired soft pinkish clay and are hand painted and probably date from the eighth century of the Christian era They may be regarded as sculpture rather than pottery there is so much expression in the faces. These are relics of a time when the art of the West was at a standstill, and they speak volumes of the great vitality of the art of the East All these figures are in the Metropolitan Museum of Art to which we are indebted for the photograph

THE LORE OF THE ARCHAEOLOGIST FROM THE STAR MAPS OF AN EGYPTIAN TOMB TO CHINESE STATUETTES



Terfezia leonis one of the Terfas so highly prized by the ancients — The Italian truffle *Tuber magnatum* which sometimes weighs twelve pounds — The white truffle *Tuber album*, which usually projects out of the ground — The Perigord truffle' or French truffle," *Tuber melanosporum*

Four varieties of truffle shown externally and in cross section, with, in three instances, a microscopic view of a single spore-sac with its contents

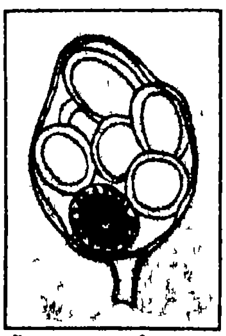
Truffles and Truffle Hunters

Some Details About One of Europe's Lesser Known Crops and Its Harvesting

By William Alphonso Murrill, Ph.D

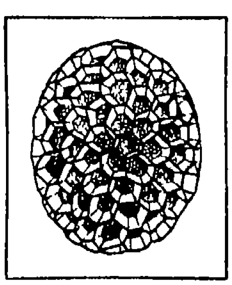
New York Botanical Garden

FEW native Americans know much about truffles because they never saw any—except perhaps in slices on an occasional dish of meat served in a restaurant but many of our foreign born population know them intimately because they are abundant in Italy and France and occur in smaller quantities in northern Europe and England. The truffle gets its name from the Latin word *Tuber* and it occurs singly or in small clusters in the soil beneath certain kinds of trees. In shape it is rounded or irregular, about the size of a walnut, and varies in color and markings according to the species, often being black and covered with coarse warts. The color of the interior also varies but it is always solid like a potato and usually mottled with white veins. Its most important characteristic by which it is detected and by reason of which it is valuable is its decided aromatic odor. This odor is sometimes offensive when mature freshly gathered truffles are brought into a room in quantity but in the young stages or when cooked it is always agreeable though sometimes rather weak.



Spore-sac and spores of *Tuber aestivum*, known in Europe as the "summer truffle" or "English truffle" It strongly resembles the "Perigord truffle" externally, but only so

When one hunts truffles in the woods in France or Italy one goes first of all to the oak trees and afterwards looks under beeches and hazel trees. They are also to be found under chestnut birch willow poplar elm etc but not to the same extent. An old saying in France is, If you want truffles plant acorns and this has been done on a large scale in many of the truffle districts with great success where the drainage is good and truffle eating animals are excluded. It would not be effective outside of the truffle districts because there would be no spores or spawn present to start a crop unless these were introduced in some form.

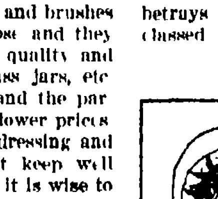


Spore of *Tuber canaliculatum* a new truffle recently found growing in Michigan

The time required to produce a crop of truffles after planting oak trees varies with the soil and climate. Some truffles usually appear in five or six years more in eight or ten and a maximum harvest may be expected between fifteen and thirty five years. The soil should be light well drained shaded free from stones and contain a certain percentage of both lime and clay. Warm weather and copious rains are essential especially in late summer. In dry seasons truffles remain small and are liable to rot or be destroyed by insects. They are also ruined if the frost reaches them.

Most of the species are mature and ready for harvesting in the autumn or at any time during the early part of the winter when the ground is not frozen the full season extending from August to March. They are found from a few inches to nearly a foot below the surface of the soil and are located by means of the strong aromatic odor which emanates from them. Squirrels hogs and other animals dig them up and devour them with the utmost enthusiasm.

As the human nostril is not usually sensitive enough to detect this odor at a distance through several inches of earth the prices of truffles would obviously be considerably higher were it not for the trained truffle-hunting pigs and dogs, which enter into the sport with great zest and are able to locate truffles under favorable conditions forty or fifty yards away. The choice between pigs and dogs is one of economy companionship and the area to be covered. Dogs do not tire so quickly but they are subject to more distractions. Water spaniels and pugs are frequently used being trained at an early age by hunting for food mixed with truffle peelings and buried in the ground. The animal is never allowed to taste a truffle any more than a setter or pointer is allowed to chase a rabbit. A well trained truffle dog sells for from forty to a hundred dollars.



Spore of *Tuber unicolor*, found near New York City

Truffles are also found accidentally when digging or ploughing or a hunter of long experience may use his judgment and with some confidence dig in favorable bare spots under trees of the proper kind and age or he may allow himself to be guided by certain small flies that appear to frequent the truffle beds.

In preparing freshly dug truffles for the market, the soil is first removed by the use of water and brushes made specially for the purpose and they are then graded by size and quality and preserved in cans, boxes, glass jars, etc. The best grades are peeled and the parings sold separately at much lower prices. Truffles are used chiefly for dressing and garnishing. As they do not keep well after being exposed to the air, it is wise to buy them in small containers and use them soon after opening.

As a food, truffles are wholesome and easily digested, while their aromatic qualities undoubtedly promotes the digestion of foods with which they are served. The ancients dedicated the truffle to Venus as encouraging love, and in more modern times it was a current saying that "those who wish to lead virtuous lives should abstain from truffles." Even in quite recent years *Elaphomyces variegatus* a fungus resembling a truffle in shape and habit, was commonly sold under the name of "Lycoperdon nut" for its supposed aphrodisiac qualities.

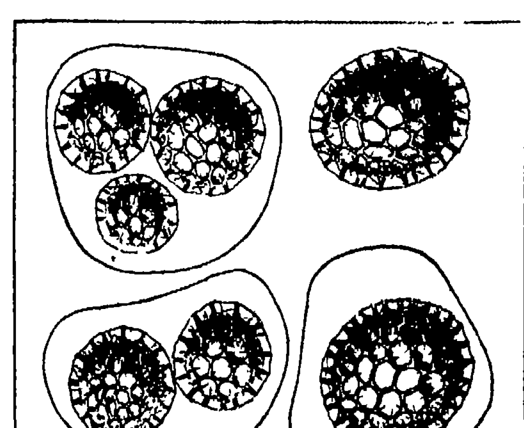
False truffles may resemble the real ones externally and grow in similar places, but they can always be readily distinguished by their spores, which are borne free on the ends of minute threads instead of being enclosed in sacs. True truffles when examined microscopically are found to contain imbedded in their flesh, numerous, minute, transparent sacs filled with from four to eight large spores, which are beautifully and characteristically ornamented.

The common hard skinned puffball, which occurs so abundantly during summer and autumn on the top of the ground in thin woods, is *not a truffle*. There are other false truffles, however which are really good, such as the 'red truffle' of England *Melanogaster variegatus* which, although little larger than a marble, has a strong and agreeable odor and is eaten in the raw state with keen relish.

Among the various species of truffles known to science the following may be mentioned and briefly described.

The Terfas highly prized by the ancients, are well represented by *Terfezia leonis* which is found in Italy and elsewhere in the Mediterranean region during the spring months and was reported from Louisiana in 1887 as occurring plentifully in red sandy land near a river. It is smooth and pure-white when fresh becoming pale-reddish brown on exposure to the air. The sacs contained eight spores, which were conspicuously warted. This species resembles a potato externally and is eaten raw at times, being sliced and dipped in oil though it is without odor and its flavor is rather insipid. Several kinds of Terfas occur in Asiatic Turkey, Persia the Libyan Desert, and Algeria where they form an important part of the diet of the Arabs. They grow under species of Cistaceæ in sandy soils containing lime which are enriched by the overflow of streams after the heavy spring rains. As they develop very rapidly in favorable seasons, the soil above them becomes cracked or slightly raised which betrays their presence to experienced eyes. Although classed with the edible truffles they are so different

(Continued on page 368)



Spores and spore-sacs of *Tuber Shearii*, a new American truffle from Maryland

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

The bumper that does not interfere with parking

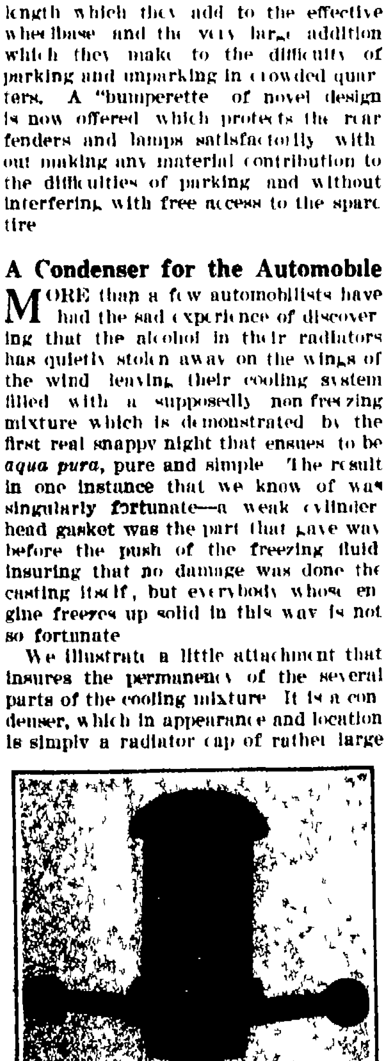
The Bumper that Is Never in the Way

BUMPERS are a very fine thing, always, and a necessity sometimes but every driver who carries them must have had occasion to curse the extra length which they add to the effective wheelbase and the very large addition which they make to the difficulty of parking and unparking in crowded quarters. A "bumperette" of novel design is now offered which protects the rear fenders and lamps satisfactorily without making any material contribution to the difficulties of parking and without interfering with free access to the spare tire.

A Condenser for the Automobile

MORE than a few automobilists have had the sad experience of discovering that the alcohol in their radiators has quietly stolen away on the wings of the wind leaving their cooling system filled with a supposedly non-freezing mixture which is demonstrated by the first real snappy night that ensues to be *aqua pura*, pure and simple. The result in one instance that we know of was singularly fortunate—a weak cylinder head gasket was the part that gave way before the push of the freezing fluid insuring that no damage was done the casting itself, but everybody whose engine freezes up solid in this way is not so fortunate.

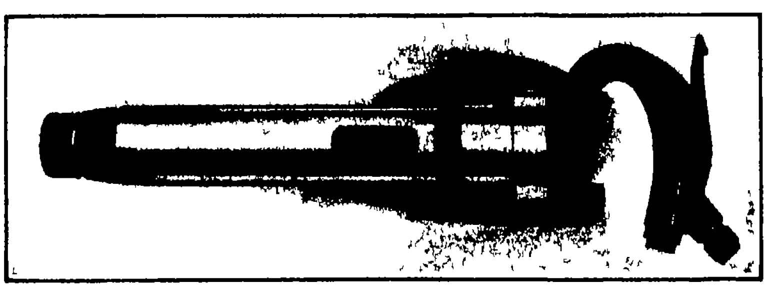
We illustrate a little attachment that insures the permanency of the several parts of the cooling mixture. It is a condenser, which in appearance and location is simply a radiator cap of rather large size and unusual design. The saving of alcohol and the prevention of unexpected freezing are but two of its advantages. It prevents the evaporation of the water even more effectually than of the alcohol. This makes it possible to run indefinitely without the nuisance of refilling and it also makes practicable the use of soft or even distilled water in the radiator thus eliminating the source of the major part of the dirt that clogs the average radiator so badly. Again with the radiator always full the solder is seldom or never exposed to the air and hence its crystallization is prevented and here is avoided the source of most of the spontaneous radiator leaks that are so annoying.



Radiator-cap that serves as condenser to prevent loss of fluid from the cooling system of the automobile

Better Riveting Hammers

OUTSTANDING features of the new riveting hammer illustrated herewith include bolted construction for holding the handle to the barrel, heavy section valve with liberal bearing surfaces, combination poppet and piston type throttle-valve, power in excess of all ordinary requirements, low air consumption and exceptionally easy operation. Three alloy steel bolts of substantial size fitted with lock washers hold the handle to the barrel and enable the tool to be taken down for inspection or cleaning with the use merely of a wrench—no vise, crowbar or other tools being necessary. The throttle valve has the nicety of control of the piston valve, with the freedom from leakage of the poppet type. The throttle lever or trigger is made in one piece from special heat treated spring steel and has a long bearing in the handle which enables it to withstand a lot of abuse. The valve operates in a box of strong construction, located in the head of the barrel. It has a solid end which makes it possible to take it apart without recourse to a screwdriver. This construction also permits a compression chamber in the valve box which cushions the piston on the return stroke and prevents it from striking the handle. The exhaust is through the side of the barrel near the handle and can be steered in any direction by the operator.



Newly designed riveting gun with outstanding advantages

The All-Weather, Noiseless Motorcycle

IN three points the motorcar scores heavily over the motorcycle: in comfort of travel, in protection from the weather, and in silence. But a new type of motorcycle recently brought out in England affords all the comfort and silence of a car while also great strides have been made in protecting the rider from mud thrown up by the wheels.

To test the silence of this new machine, two observers were stationed at a certain point towards which a standard car and the new all-weather cycle travelled. The distance at which the vehicle was first heard was carefully measured. The car became audible at a distance of 131 yards from the observers, the motorcycle which is fitted with a three-horsepower sleeve-valve engine, was first heard when 70 yards away.

The engine is completely enclosed, also the chain transmission. The frame is triangular and of a new design giving great strength and rigidity at low weight. The saddle is supported by a link and two long and powerful springs. Legshields of ample size protect the rider in bad weather while the engine and its working parts are quite as well protected as in a motorcar.

Vaporized Metal

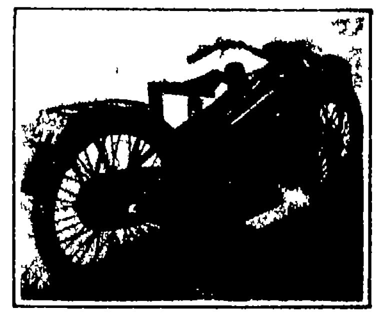
BRONZE-covered statues, copper-covered shingles, concrete piles or railroad ties are some of the possibilities ensuing from a process for spraying metals, which after years of study is approaching perfection at the U. S. Bureau of Standards.

The essential of the process is that the metal is first vaporized by the use of electricity and then sprayed on to the surface to be coated by means of a powerful blast which congeals it to the solid form as quickly as it strikes the surface. Applications of the method which results in a firm coating of metal upon any surface to which it is applied are many and varied. Stone, wood, metal and glass are all equally suitable basic surfaces. Pottery may be successfully coated with metal pointing to important developments in ceramics.

An important application is in the use of the metal coating in building construction. Shingles may be made fire-resisting by coating them with copper which weathers well and produces an artistic green color on the roof. Experiments are already being made along the lines of copper coating other roofing material and stucco.

Soldering of metal to glass, a difficult problem, has been easily accomplished by means of this method. The glass is first coated with a layer of copper and the metal connection is then soldered to the copper. Processes somewhat similar are used in the soldering of aluminum.

On the decorative side the uses of the method are many. Statues or other sculptured designs may be hewn from soft and easily worked stone and then coated with bronze, giving the effect of a bronze statue and weathering equally well. Gold and silver plating or decoration may be applied in the same way to furniture or table ware.—*Abstract from Science for* November 9, 1923.



British motorcycle that possesses several features heretofore obtainable only in a regular automobile

A Protecting Cover for Shallow-water Cables

SUBMARINE cables lying in the neighborhood of the coast must be protected in the water as well as on land against the chafing influence of the movements generated by the waves. Till now there has been used a flexible armoring of thick steel wires which protected the inner parts of the cable very well. But this kind of armoring has the drawback that it cannot be made flexible enough to follow the forms of the cliffs and stones on rocky coasts. Such a steel armored cable when lying on rocky shores was partly on the ground and partly hanging in the air. Consequently the stresses on the cable were far from uniform: one part was violently moved by the waves, the other one remained absolutely quiet.

To a new cable laid recently on the Norwegian coast by the Siemens-Schuckert Works a new kind of protection was applied which enables the cable to conform closely to all unevennesses of the ground under water as well as on land. This new armoring consists of link boxes of cast iron which overlap each other and are arranged in the manner of ball and socket joints. In consequence of their great flexibility these link boxes follow with the utmost accuracy the topographical formation of the sea ground as well as of rocky coasts. In order to avoid all movements the cable armored in the manner just described is fixed on the rocks and on fitting parts of the coast with iron clamps. The cable is arranged in the ship's hull with

Not the latest sea serpent—merely a scheme for protecting cables at and near their landing places

Electric washer that clamps in place upon any tub

out the link boxes and it is also laid out without them. After the end of the cable is brought to land these link boxes are installed. On the dry rocks of the coast this is simple enough. In the not too deep parts of the sea the laborers take the cable after being laid out into a boat and install here the link boxes. Installation of the clamps is made during ebb-tide. On the deeper parts this work is done by divers.

The Hose-Holder for Fire-Fighters

NO longer is it necessary for the fire-fighters to struggle with a big hose, filled with an unruly snake of water that whips and struggles to get away from them, and calls for the heaviest kind of handling in keeping it under control. An Atlantic City inventor has put out a big, heavy nozzle-holder which holds the most powerful stream of water steady as a rock. Not alone does it save the display of brute strength which we are accustomed to see at a fire. It saves the services of three firemen to each nozzle and releases them for more active work. Also it means that once set the stream will be directed without deviation or uncertainty upon the spot at which it is aimed. The hose holder comes in two models. There is the type that clamps upon the side of the fire truck as illustrated and there is a ground stand for independent use without any further support. At a recent demonstration in Atlantic City twelve streams were shot from a single ladder truck without being touched by human hands after they had once been set.

An Umbrella for the Spark Plug

THE little device illustrated it is claimed by its manufacturer catches the flying oil and prevents it from fouling the spark plug. It is attached by sliding it over the ground electrode after which the slot is closed by bending the shield upwards over the electrodes.

Keeping the oil and soot off the spark plug

An Electric Washer for Any Tub

A DECIDEDLY ingenious cylindrical electric washer that clamps upon any tub or washboiler is different from others now on the market. Inside the cylinder is a little motor that water does not hurt. Neither does it drip oil. The motor runs a four blade fan situated a few inches from the base of cylinder. This fan does the work by shooting out jets of water showing five pounds to the square inch by test. Water enters the cylinder through small holes surrounding the orifice of the jet. When the water is thrown out it strikes along the sides of the tub swirling the clothes with it in the process of cleansing.

Paring the Phonograph Needle Without Removing It

THERE is more than one good reason why a fiber needle should be used when records on phonographs are being played. There has however been the tiresome task of removing the needle from the tone arm in order to cut it off after once having been used on a record. A Chicago manufacturer has now perfected a small metal cutting device that cuts the needle without removing it. It is run under the needle as shown in our illustration and the lever pressed down by the first finger. This operates a cutting knife. Back of the cutting knife a small receptacle catches the discarded part of the needle.

New But Simple Method for Changing Cast Iron Into Steel

ONE of the most interesting developments in the realm of iron foundry practice which has been announced in several years is the result of extensive experiment in research largely during 1923. The findings are somewhat sensational and revolutionary. A method has been discovered of heat treating gray or white cast iron so as to render it much more easily machinable and at the same time to bestow upon it greater strength

Rigid hose-stand for the fire brigade, which releases the firemen for better work than holding the hose

than it has ever been possible to develop heretofore. Not only have the machining qualities been greatly increased or benefited but the strength and pliability of the iron has been strikingly augmented. Tensile strengths as high as 98,000 pounds per square inch have been obtained together with a limited amount of pliability and also marked resistance to shock and fatigue stresses.

The most interesting and notable feature of this new process is the conversion of white iron into a product not only equal to but superior to malleable iron, in a period of time much shorter than that required in the regular malleable process.

The inventor of this process is Alexander K. Schaap of Brooklyn. The process as thus far developed is exceedingly simple and consists in heating cast iron to a temperature shortly above the temperature of 1600 degrees Fahrenheit, protecting it in a muffle surrounded by a gas flame and open at the top. In the case of gray iron as soon as it has reached the proper temperature the muffle and its contents are removed from the furnace and allowed to cool in the open air, the casting being protected from drafts by placing a cover on the top of the muffle. The muffle itself is made of wrought iron and it has been found that this is the only material that can be used to obtain the results desired, muffles made of clay, graphite, steel and other metals being used without success. By this method it requires only about fifteen minutes for the iron to cool to a black heat after which it is cooled in the air.

The method as outlined above has been in continuous use for more than a year, chiefly for the purpose of softening gray iron for machining purposes and

The fiber needle may now be used without the necessity of removing it from the machine to trim off the blunted end

particularly for making automobile piston rings. It may be stated according to the claims of developers that either gray or white cast iron is not only converted into a product similar to malleable iron but into one which has many of the properties of steel. If the results turn out to be as favorable as now appears probable the process will mean the shortening of the time of converting white iron into malleable iron to less than an hour instead of 72 hours.

The Magnetic Susceptibility of Gases

THE method used in an interesting investigation by A. P. Wills and L. G. Hector was that of balancing the gas magnetically against an aqueous solution of nickel chloride. By varying the concentration of the solution it could be given a susceptibility approximately the same as that of the gas, then by varying the pressure of the gas or the temperature of the gas and soution both could be given the same susceptibility. A manometric balance of great sensitivity enabled the observer to tell when the susceptibilities of the gas and the solution were the same. For both paramagnetic and diamagnetic gases formulas are derived from which the susceptibility may be calculated from pressure and temperature observations on the gas when it is magnetically neutral against the solution. The volume susceptibility under a pressure of the atmosphere at the temperature 20°C was found to be $+0.1447 \times 10^{-6}$ for oxygen, -1.64×10^{-10} for hydrogen, and -0.81×10^{-10} for helium. The result found for helium is about 25 times less than Tänzler's value, but when substituted in the formula derived by W. Pauli, Jr., for the diamagnetic susceptibility of a monatomic gas, it yields a result bearing on the dimensions of the atom which is compatible with our knowledge from other sources.

Ice saw that works directly off the motor

Sawing Ice in a New Way

DOING away with the usual counter-shaft transmission of the conventional motorized ice-saw, the latest machine of this description uses the small-car engine, direct-connected to an inserted tooth buzz-saw. The resulting elimination of weight is a factor of importance, and in addition the cutting capacity, it is said, is increased. The frame of the apparatus practically surrounds the rapidly revolving saw protecting anybody who might come too close to it for comfort. It is entirely self propelling on smooth ice and has a cutting speed of three feet per second with a nine-inch cut.

New Automatic Enlarger

A PROPER darkroom is no longer required for the use of the enlarger illustrated here, any room can be used after having been darkened. The special feature of this apparatus is a ruby lamp mounted to the foot of the second column, this lamp is controlled by a double switch which also controls the main enlarging lamp.

A first pressure on the switch lights the ruby lamp, so that the sensitive paper can be placed in position, when the switch is pressed once more the ruby lamp is cut off and the main enlarging lamp thrown into the circuit.

A few seconds suffice for the exposure, if fast bromide paper is used then the ruby lamp is switched on again and by its light the enlargement is developed.

The vertical column of the apparatus carries scales which indicate the necessary extension for the camera and its distance from the base plate. Once the scales have been properly adjusted no further adjustment is required.

Enlarging without a special darkroom

This vacuum-held rubber hook will support a twenty-pound overcoat

The Vacuum Hook

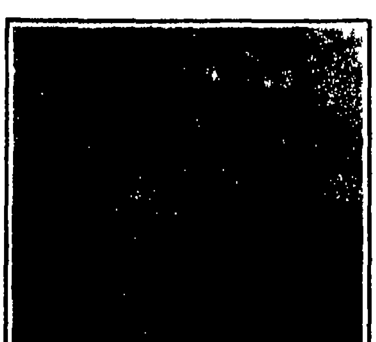
GREAT holding power is claimed for this rubber vacuum-cup with flexible rubber shank. Up to weights of twenty pounds it will firmly support whatever may be hung on it—it is even used as an overcoat hanger. In window dressing displays it should be found of great utility. It is claimed to provide a perfect adhesion to glass, marble, enamel, metal, polished wood, or in fact any non-porous surface without the use of glue, paste, stickers, or any adhesive substance.

The Self-Sharpening Lawnmower

WHEN a lawnmower is sharpened in this device it is necessary to remove nothing but one wheel. In the place of this wheel a clutch pulley is fitted and this serves to turn the blades of the mower while they are being sharpened. Powdered emery dust or carborundum is placed on a piece of thin cardboard and a thin paste is formed by the use of a little machine oil and the reel draws in the compound as the mower is in motion. This compound on the cutter blades of the reel serves to sharpen the blades and the cutter bar at the same time. The motive power for running the device is furnished by a one-quarter horsepower electric motor.

A Bigger, Better Bath-Spray

IN this bath spray the water sprays through holes in the metal container back of the applicator portion instead of from rubber prongs as in so many sprays. Six groups of rubber prongs are arranged in a circle around the outside of the container while in the center a round piece of sponge rubber is placed for use as a sponge. A sanitary feature of this spray is that the applicators may be removed for cleaning behind them.



Bath spray that gives a more effective shower of water

New Wood-Drying Process by Ozone

THERE are actually two principal methods for drying wood, open air and steam kilns.

The open air process requires from four to ten years, while modern industry requires a prompt supply of material. Moreover it entails the constitution of an enormous stock and the tying up of large capital.

The steam kilns produce a dried wood but the amylaceous and the resinifiable substances undergo slow oxidation which is accompanied by contraction in the contents of the cells; as a result the wood gradually shrinks, the starch which still remains unaltered in the cells attracts parasites and gives rise to the formation of mold. Moreover these unchanged components of the cell sap are distinctly hygroscopic; consequently the wood absorbs moisture again from the air. The general effect is to leave the cells empty, thus rendering the wood brittle and lifeless.

The process of seasoning wood by ozone produces a material well dried and seasoned. As a matter of fact no process is capable of producing the same results as natural seasoning unless it provides for the oxidation without elimination, of the organic components of the cell sap. If an artificial oxidizing agent is employed for this purpose, it must act rapidly. It must penetrate to the innermost portions of the wood without affecting the ligneous tissue, diluting the sap, or discoloring the wood and it must leave no residue. The oxidizing agents employed in chemical industry cannot do that. Ozone on the other hand fulfills all these conditions and is capable of reproducing exactly the phenomena of seasoning by exposure to air but at a rate many hundred times more rapid.

Sharpening the lawnmower without taking it apart

The ozone wood-drying process was invented by Mr. M. P. Otto, a French Civil Engineer, Doctor of Sciences, who has devoted his studies to ozone and its results in all kinds of spheres. After a long course of experimental work Mr. Otto has now established it industrially.

There are now in Paris and near Paris two plants which dry wood for all kinds of industries, the demands of which are so extensive that those two plants cannot meet the requirements of the manufacturers. Some more kilns are to be erected in the near future.

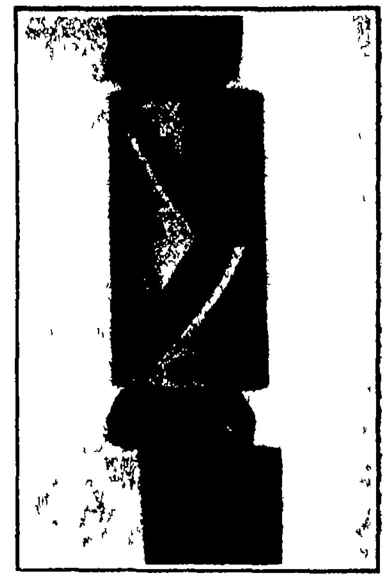
In Italy, at Seregno near Milan there is another plant, and England is about to adopt the process.

In the ozone process the wood is submitted successively to the action of hot air, or ozonized air and of a mixture of ozonized air and hot air. The duration of the treatment varies according to the nature and the thickness of the wood from four to twenty days. In that period green wood is converted into seasoned wood possessing all the characteristics of wood exposed to the action of air for ten years. There is no case hardening, checking or warping. It must be pointed out here that wood brought green to the kiln comes out ready for use, therefore it is not necessary to stock before or after the process.

The manufacturers using the process in France are unanimous in declaring that after being finished all articles show a perfect polish equal to ivory, which proves that the wood is a compact and unalterable body. The "Conservatoire National des Arts et Metiers" has examined the process in its experimental laboratory and fully confirms the results claimed by the inventor.

A Bulldog Splice for Wire Rope

THERE are legions of splicers but most of them are larger than the wire. It has remained for a Mansfield, Ohio, manufacturer to produce one which when applied is no larger than the wires spliced. This simple little appliance is made of bronze and has a number of teeth on the inner surface whose purpose is to grip the stranded conductor and hold on tightly. It is closed by means of a hammer and no solder is needed. The finished splice is covered with tape. There has been a long recognized need for just such a thing as this where work must be done in a hurry and with portable tools.



A wire splice that is no larger than the wire yet holds like grim death

Measuring Strains by Electricity

THE measuring of the strains of bridges, skyscrapers, airships and structural material in general has been made possible by electricity through the use of a device recently perfected by the U. S. Bureau of Standards. The device has the great advantage that results may be read or recorded anywhere although the gage itself may be in a difficult and inaccessible location. The principle employed by the inventors Messrs. B. McCollum and O. S. Peters is that of the varying electrical resistance of many closely adjacent thin carbon plates when subjected to a compression or pulling strain. Heretofore there had always been insuperable difficulties in the way of practical application of this principle. The gage is now in use in a series of tests of impact strains on highway bridges that are being made at the Iowa State Agricultural College. The gage has also been tested on railway bridges. The device is small in size, being about 10 inches long, less than five inches wide, and about an inch and a half thick. The reading apparatus is a specially constructed voltmeter. By connecting wires from the instrument to an oscillograph graphic records of stresses have been made. The invention is not only very sensitive but it recovers itself so quickly after the strain has passed that it may be used in the measurement of vibratory or transient strains with a duration no greater than one thousandth of a second. —*Abstract from Science for Oct. 7th, 1923.*

The machine that runs through the entire catalog of woodworking operations

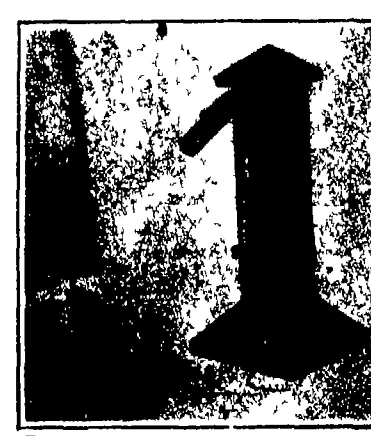
The Woodworker's Jack-of-All-Machines

WE illustrate a clever new woodworking machine-of-all-work, which will do cross-cutting, ripping, mitering, bevelling, matching, molding, irregular shaping, dadoing, routing, sanding, boring, turning, fluting, tenoning and panel raising—on any rake or bevel. It sounds like a large order but the machine looks capable of filling it.

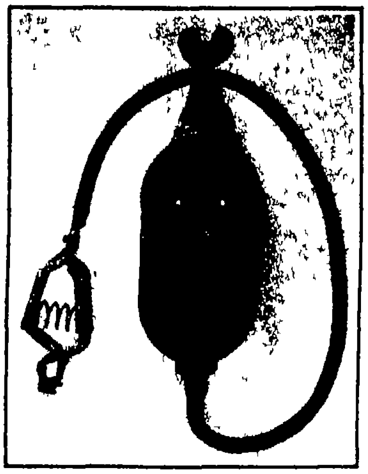
There is a base casting which supports a sliding vertical column elevated and lowered by screw and bevel gears with crank attached. One turn of the crank raises the column one-eighth inch. The column supports a rigid one-piece horizontal arm machined on the inside to receive a slide block which carries a yoke and motor assembly. This horizontal arm is thirty inches long and swings right or left in a complete circle. Graduations at its point of contact with the column enable the operator to set it quickly to cut any angle. The yoke is suspended from the slide block by a square head shaft which seats in a milled way in the top of the slide block. The motor may be turned to right or left and seated in any of four 90-degree positions. The motor is pivoted in the yoke, swinging from horizontal to vertical and being held in either or any intermediate position by clamp nut. Ready means is provided for quickly determining the horizontal, vertical and 45-degree positions. The machine works with any stock up to two inches.

Fountain Pen for Public Places

PEN service for those who have no pen of their own is furnished by this recently patented writing device. The illustration shows the pen removed for writing. After use, the chain to which the pen is attached is pulled taut and run back in the base. It can be locked in any position for convenient use. A pull of the chain to the side between the small pulleys catches the



Fountain-pen service for the public writing-station



With this simple combination of ammeter and variable resistance, any desired rate of battery charging may be obtained

chain and holds it till released while within the base is a weight which pulls the chain back into the base after the writer releases it from its position between the rollers. Its operation is much the same as that of a windlass.

Hoisting by Air

THE air motor hoist illustrated on this page employs a balanced three-cylinder air motor which operates in either direction and at any speed or hoist at any speed. A safety stop lever prevents over running the top or bottom of the travel of the hoist. The automatic brake holds the load at any point for any time, regardless of the air pressure. The new hoist is marketed in five sizes, from five hundred pounds up to five tons.

Variable Charging with Minimum Fussing

ANY user of constant potential with the aid of the simple connector illustrated may enjoy the use of modified constant potential without the bother of buying a lot of variable-resistance connectors. The appliance consists of a special clamp fastened to the bus bars, into which is built a special carbon pile resistance, together with an accurate-reading ammeter showing just the rate of charge going into the battery. By turning the knob below the meter practically any desired rate of charge may be obtained. The connector is marketed with eighteen inches of No. 4 rubber covered cable and special battery connection.

A Novel Pump of Fine Performance

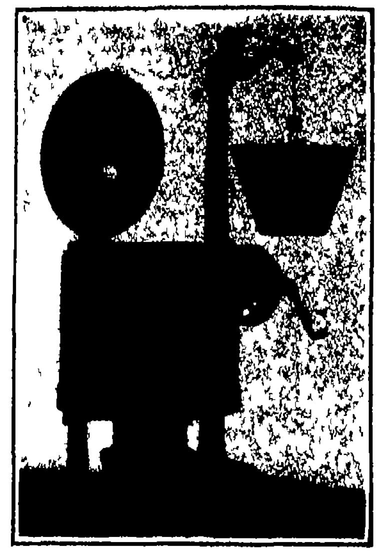
AMONG the interesting experiments which come to our attention a high place goes to the novel pump assembly which is now being tested out in the laboratory of Detroit University by Charles W. Jackman. The left hand member of our series of five photographs shows the set up which has been used in

Centrifugal Extractor of Interesting Design

IN the electrically driven centrifugal extractor shown herewith, all belts, countershafts etc. are eliminated. The motor is mounted directly upon the spindle of the machine—a distinctly modern tendency in the effort to get away from driving complications and one to be observed in a very wide variety of electrically driven apparatus. The machine may be brought up to speed under full load in ten seconds and stopped in twelve. By means of a novel compensating feature in the assembly of the motor with the chip-pan unit all the vibration so common to this sort of machinery is transferred to the base, where it is easily controlled.

The lower motor bearing carries radial loads only; the upper bearing carries radial loads, as well as the thrust load of the pan assembly spindle and chip load. The weight of the entire assembly is carried by a pivot bearing in the base of the machine. The machine is equipped with a safety cover which automatically locks the drum control whenever it is raised.

Not only is safety obtained by thus preventing the operation of the machine except when the cover is closed but splashing of oil is also prevented. The chip pan has a capacity of two bushels, in the size now being marketed but the same application will be made to other sizes in due course. The machine has an obvious availability for a large range of extraction work

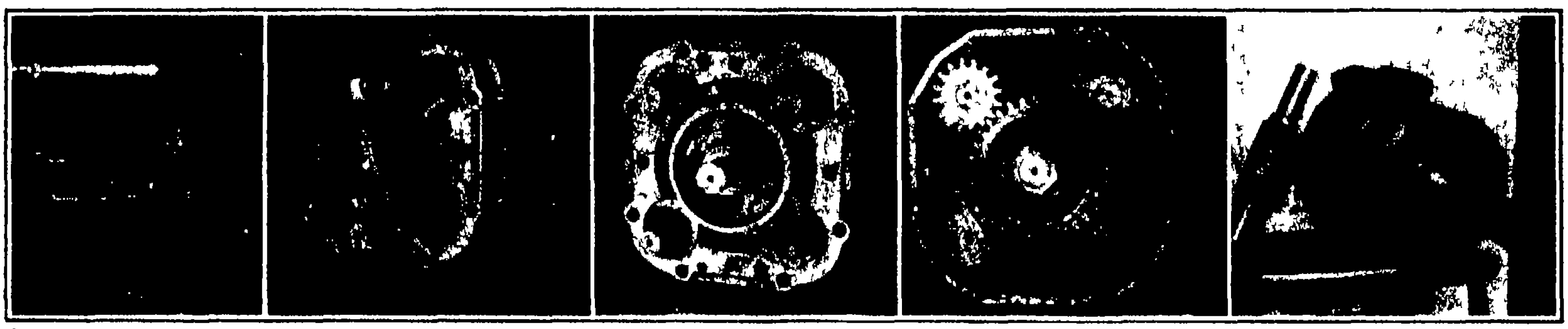


Electrically-driven centrifuge of unusual simplicity in design and operation

characteristic of the plant in this connection is that unlike many algæ it can flourish in water in excess of ten feet deep.

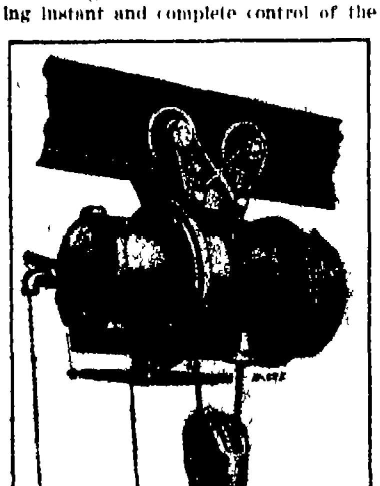
An Electric Hand-Shaper

ILLUSTRATED herewith is an electrically operated hand shaper of interesting design shown at work. A specially patented cooling device permits the entire



The complete test installation (left) and four views showing the working parts of a pump which has run under test with volumetric efficiency of ninety per cent

load within the rated capacity of the machine. The manufacturer emphasizes that this is not a direct acting hoist consisting, as the latter do, essentially of only a plunger and a case. It comprises an air motor geared through a mechanical train to a hoisting drum. Throttle graduation is very fine, insuring instant and complete control of the



Hoist driven by air motor in a novel and better way

these tests. A trunnion has been brazed to the gear cover and a ball bearing (not visible) fitted to it. A second ball bearing is fitted to the shaft of the pump, and the whole affair including the short pipe connections pivots on these bearings. A large tank is placed below the pump and the inlet is through a short vertical pipe. The discharge is from the top through the venturi meter and throttling valve. The pump is on its side to accommodate the connections. The motor power available is a horizontal steam-engine much larger than necessary but giving a steady though flexible flow of power.

As for the pump itself the present model is fitted with balance pistons on the impeller to eliminate end thrust. The large out swept annular volume is displaced twice in each revolution giving a big output for the size of the pump. The discharge is perfectly uniform and pulseless. The pistons are in constant contact with the casing, making the leakage small. There is no contact between pistons and abutments and that between impeller and abutments is a true rolling contact on circular surfaces. The gear timing may vary within wide limits. The rubber covering of the abutment segment (shown in the final view) eliminates leakage between the abutments and the impeller during the period of rolling contact, the rubber being then compressed slightly. As a result of this, the volumetric efficiency is something like 90 per cent.

New Discovery in Mosquito Suppression

THE discovery that a certain kind of alga growing in still or stagnant water has an important use in partially limiting the growth of mosquito larvæ in such waters announced in 1919 by a Spanish professor has been supplemented by another Spanish scientist who has now found a new and more effective species of water plant, identified as *Chara Hispida* which keeps the water in which it grows completely free from these pests. This plant was found growing in the swampy regions near Valencia; pools in which it occurred were found to be completely free from the larvæ while other pools from which *Chara Hispida* was absent were found to be well populated with the wigglers.

These observations made in the swamps were later confirmed by small scale experiments, in the course of which the larvæ of Stegomyia were introduced into water in which the *Chara* plant was growing. They all died. Further observations in the laboratory and in nature have confirmed the essential antagonism between *Chara Hispida* on the one hand and the different kinds of mosquitoes (Stegomyia, Culex, and Anopheles) on the other. The hemp retting ponds near Valencia were later found to contain a rich growth of *Chara*, and to be entirely free from mosquitoes.

Further work is being done with the view of enlisting the aid of this plant in mosquito eradication. A valuable

assembly, motor and all, to be thus held in the hand while developing a speed under load of 8500 revolutions per minute. Without the load the one-eighth horsepower motor attains as high a speed as 18,000 revolutions. The tool is obviously an extremely convenient one for a wide variety of small shaping jobs.

The motor develops 8500 revolutions under load, but can be held in the hand without discomfort

The Heavens in May, 1924

Some Details About the Transit of Mercury, Occurring this Month

By Professor Henry Norris Russell, Ph D

THE present month is noteworthy for an unusual phenomenon visible throughout the United States—namely, a transit of Mercury across the sun's disk, on May 7th. On this date the planet comes directly between us and the sun, so that it is visible as a small black spot upon the solar disk—too small, however, to be seen with the unaided eye as it is only twelve seconds of arc in diameter. A good field glass, equipped with a suitable shade to diminish the sun's glare, should show the planet—and this may be a good time to remind ourselves that an old fogged photographic plate developed until it is so black that the sun can just comfortably be seen through it, makes an excellent shade for this purpose.

The smallest telescope should show the planet distinctly. The shade-glass should in this case be placed between the eye-piece and the observer's eye, as any home made affair will inevitably be of such optical quality that, if placed in front of the objective of the telescope, it would spoil the image completely.

The planet, as seen from New York begins to enter upon the sun's edge at 2 42 P. M., Eastern Standard Time. For points on the Pacific Coast the moment of entry is not quite a minute later by Greenwich time (though obviously three hours earlier by local time). For all American stations the point of first contact is very near the uppermost point of the sun's edge as it appears in the sky at the time.

Three minutes later the whole disk of the planet will have entered upon the sun's face, and from this time until sunset it will be visible as a black spot moving slowly downward and to the right. The planet's track takes it almost centrally across the disk, and the full transit requires about eight hours but long before that time the sun will have set for the western world. The end of the transit will be visible in Europe, just after sunrise on the 8th.

With a field glass little more than the existence of a tiny black spot can be detected and it may be hard to distinguish it from a sunspot, if there happen to be many of the latter—which is unlikely as we are near the time of minimum. By making a sketch of any spots that are visible before the planet enters upon the sun identification of the invader can be made certain—as also by the planet's motion. The observer must remember however, that the sun appears to turn *relative to the horizon* as the day advances and that a spot which is on the right hand edge of the sun at noon will seem to shift about 40° toward the bottom of the disk before sunset—and be on his guard against confusing this apparent motion of the sun and his spots with the real motion of the planet. The changes in the distance of the planet from the sun's edge of course, afford a safe guide.

With the telescope it can be seen if the air is steady enough that the planet is perfectly round with a hard sharp edge—unlike the sun's spots which are irregular, and show less contrast. Under good conditions, too, one may note that the planet looks darker than the spots—black while they are brownish—a proof that the spots are not perfectly dark but shine with a light of their own fainter than that of the rest of the sun.

The most important observations, from the astronomical standpoint, which can be made during the transit are determinations of the exact times when the planet first invades the sun's limb and when it is completely projected upon it—and perhaps also photographs showing the planet in front of the sun, the object of both sets of observations being to find the exact position of the planet in the sky, compared with the sun at a known instant. In these days of radio time signals, good observations of the time of internal contact may be made by amateur observers (with telescopes of at least six inches aperture, and good seeing) provided they have reliable watches, and compare them with the radio signals both before and after the transit, without attempting in any way to regulate them between times.

The Schedule of the Transits

Mercury goes around the sun four times every year, and catches up with the sun three times. Why then are these transits so rare? As everyone knows the reason is that the plane of Mercury's orbit is inclined seven degrees to that of the earth's, so that the planet usually passes far above or below the line joining us to the sun. Only when a conjunction occurs close to the intersection of the two orbit planes (the line of nodes), can there be a transit. The earth reaches these points in its orbit upon May 5th and November 7th, and all transits must occur within a few days of the one date or the other.

The law of their repetition has been worked out in beautiful detail by Newcomb. In 46 years Mercury goes around the sun very nearly 191 times and therefore catches up with the earth 145 times. At only six of these conjunctions is he within the limits just mentioned so that the average interval between transits is about eight years. The actual interval between successive transits may be either 3½, 7, 9½ or 13 years according to circumstances but it never exceeds the latter value. November transits are about twice as numerous as those in May because in the former case Mercury is much nearer the sun and may then be a greater number of miles from the plane of the ecliptic without getting out of the line between us and the sun's upper or lower edge.

The 46-year interval is not quite exact though series of May transits succeed one another at this interval for about 400 years and of November transits for more than 800. A longer cycle of 217 years during which Mercury makes almost exactly 901 revolutions is much more precise and transits under very similar circumstances succeed one another at this interval for thousands of years.

The last transit of Mercury was on November 6th 1914 and was visible in the United States, as were those of November 13th 1907 and November 10th 1894, in whole or in part, also that on May 9th, 1891—the last previous May transit. The next transit, on November 9th 1927, will be invisible in this country, the opposite side of the earth at this time facing the sun. The four following transits on November 11th, 1940, November 13th 1953, May 5th 1957 and November 7th 1960 will be at least partially visible in this country.

One further interest attaching to these transits may be mentioned. Since Mercury moves much faster near its perihelion than near its aphelion the times of the transits are altered when the perihelion and aphelion move giving us one of our most accurate means of determining such motion. It was in this way that the peculiar motion of Mercury's perihelion was first discovered—to be a puzzle to astronomers for a generation and to be at last accounted for by Einstein.

At 11 o clock May 7
At 10½ o clock May 15
At 10 o clock May 22
At 9½ o clock May 30
At 9 o clock June 7
At 8½ o clock June 14
At 8 o clock June 22

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

The Heavens

The Milky Way sweeps far along the eastern horizon—too low to be conspicuous itself but marked by many bright stars. Scorpio is in the southeast, not fully risen. To the left is Ophiuchus now brightened by the presence of Jupiter. Then comes Aquila due east, and Cygnus, in the northeast with Lyra above. Cepheus follows and last Cassiopeia low in the north. Ursa Minor and Draco swing high over the pole and Ursa Major is far up in the northwest extending almost to the zenith. Auriga and Gemini are setting far below. Hydra stretches along the horizon from west to south, with Corvus and Crater just above and Leo and Virgo higher. Boötes is almost overhead. Far below on the southern horizon is Centaurus. The brightest stars of the constellation Alpha and Beta Centauri are visible at this hour from southern Florida and the West Indies and the Southern Cross also low on the horizon an hour or two earlier in the night.

The Planets

Mercury is an evening star before his transit and a morning star afterwards but he is visible only near the end of the month when he rises at 4 45 A. M. Venus is extremely conspicuous as an evening star far north and very bright remaining in sight until 10 10 P. M. on the 31st.

Mars is past quadrature and steadily getting brighter and nearer as he moves slowly eastward through Capricornus. By the 31st he rises at midnight and looks nearly twice as bright as Arcturus.

Jupiter is in Ophiuchus approaching opposition and rises at 9 P. M. in the middle of the month. Saturn is in Virgo, crossing the meridian at 10 P. M. on the same date. Uranus is in Pisces rising 2 A. M. and Neptune is in Leo, setting shortly after midnight.

The moon is new at 6 P. M. on the 3rd in her first quarter at 9 P. M. on the 11th, full at 5 P. M. on the 18th and in her last quarter at 9 A. M. on the 25th. She is nearest the earth on the 23rd and farthest away on the 5th. As she makes her circuit of the sky she passes by Mercury on the 4th, Venus on the 7th, Neptune on the 11th, Saturn on the 16th, Jupiter on the 19th, Mars on the 24th, Uranus on the 26th and Mercury again on the 31st.

Distribution of Brightness on the Sun's Disk

SCHWARZSCHILD and Defant's work developing Schuster's investigation of the decrease in brightness from the sun's center to limb seemed consistent with the supposition that the sun consists of a nucleus which radiates like a black body surrounded by a cooler gaseous atmosphere which scatters this radiation. But St. John's work developing Evershed's discovery of radial motion in sunspots assumes that the sun is gaseous throughout the Fraunhofer lines being produced by absorption at different levels. A paper by R. Dietzius (*Akad. Wiss.* 131 2a 1) is now offered to show that Schuster's law of decreasing brightness can be explained quite as well or even better on this theory of a completely gaseous sun.

"This is Station ——"

(Continued from page 303)

could also function as a primary broadcaster, whenever something of local interest was to be put on the air

The telephone wire transmission seems the simplest means of accomplishing the desired end Simultaneous broadcasting by a number of stations widely separated, has been carried on at intervals by wire transmission, for some time back. Unfortunately, however the limitations of this method are considerable and the difficulties of repeating programs increase with the distance and the number of stations so that while it is technically possible to do the work in this manner from the cost standpoint it appears entirely impracticable at this time In addition a most serious limitation is the lack of flexibility at the repeating station to permit it to shift from one program center to another as it would be impossible to change the telephone wire connections without elaborate prearrangement

Radio repeating on the other hand has no such limitations and possesses flexibility to the utmost degree While only one such station—the Westinghouse station at Hastings, Nebr KFKX—is at present in commercial operation, the success already attained with this station is sufficient to demonstrate the possibilities of this method of repeating and to indicate that it marks the first step toward a comprehensive system of radio repeating which will in time cover not only the United States but the entire world according to H P Davis Vice President of the Westinghouse company Under this system we are assured it will be possible to listen in on the interesting events of the old and the new worlds.

The system is so flexible that it is susceptible of indefinite expansion without excessive cost When completely worked out the owner of every crystal or low power set, no matter where located, can listen to selected programs in which the best from every quarter of the globe can be included The primary broadcasting stations need be but few in number, but will be located where the best of program material is available

How does this radio repeating work? Simple enough—at least now that it has been worked out by radio engineers after several years of painstaking efforts The KDKA station of the Westinghouse organization the pioneer broadcaster please remember broadcasts two waves at one time The regular broadcast audiences are being entertained by means of the 326-meter broadcast while a 94 meter short wave broadcast is going out to the repeating stations. Tests have proved that the short wave or high frequency broadcasts go farther with the same power input than the ordinary broadcast waves It has also been proved that daylight which has a marked effect on the usual wave lengths, has little effect, if any, on this carrying power

Great things are bound to come out of this short wave transmission and re broadcasting Only the other day a concert broadcast by KDKA was picked up in London on a short wave receiver properly amplified and re broadcasted on the higher wave lengths used by the British broadcasters The Pittsburg concert via London was picked up in Calcutta India and held for thirty two minutes This system of short wave transmission and repeating is enabling the British audiences to listen to American radio programs, and even the French, Belgian Dutch and German listeners in may have an opportunity of listening to the fascinating strains of American jazz via the British repeating stations

Doing Away With the "Pick-Up" Wires

The possibilities of short wave transmission penetrate even deeper than this into the future of radio broadcasting Broadcasters from time to time find it necessary to transmit directly from some point outside the studio It may be a banquet, a baseball or football game, the ringside, the theatre or opera, the convention hall, but whatever it is, the usual studio microphone is replaced by a microphone in the field so to speak The 'pick up' equipment, to use radio parlance has heretofore been connected with the broadcasting station by means of telephone or telegraph wires. Such means have been ample for the purpose although truth to tell, there have been many times when the broadcasters have found it difficult and, sometimes, impossible to obtain the proper wire connections with the result that the radio audience have missed important events. And now we have

(Continued on page 354)

The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract the numerals referring respectively to the volume, number and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests appear elsewhere in this issue

Automotive

Changing to "Balloon" Tires.—Both balloon and balloon type tires are straight side and no expense is connected with changing from regular to balloon type tires on cars equipped with straight side rims. In the case of cars using clinchers the cost of the changeover is only that ordinarily incurred in changing from clincher to straight side rims. On the other hand in changing from regular cords to balloon tires on cars already in use either new wheels or new rims are necessary usually new wheels. On Cadillac and Lincoln cars the rims cannot be changed and new wheels are required. Balloon type tires can be applied with no alterations whatever to cars having sufficient fender and body clearance. This clearance must be measured between the tread of the tire and the fender at the top, forward and rear ends of the latter also between the side of the tire and the side of the body and between the side of the tire and the outer edge of the fender. Some cars have more fender and body clearance than others and for that reason single and double oversize balloon type tires are made to fit the most commonly used rims. The single oversize balloon type tire can be used in all cases but when attempting to apply the double oversize careful measurement of all clearances is necessary not forgetting the use of chains in winter and that heavy loading of the car may produce sufficient sag in the springs to cause the fenders to strike the tires in crossing obstacles. The effect of these larger tires on the gear ratio and effective power is also to be considered.—*Ind Rub World* 69 6 2 pp

What is a Balloon Tire?—Considerable confusion already exists in the tire trade and still more in the public mind as to the proper answer to this question. The term has been commonly applied to a great many sizes ranging from the 29 by 4½ and 30 by 5 six ply so called taxicab tires requiring an inflation pressure of about 40 pounds to the 34 by 7 four ply thin sidewall tire designed for inflation pressures as low as 18 or 20 pounds. Leading tire manufacturers have therefore become apprehensive lest the public hearing of the successful use of balloon tires at inflation pressures as low as 18 pounds per square inch will jump to the conclusion that all tires termed balloons can be used at this low pressure and that the results will be disastrous. To offset this tendency some are recommending even for true balloon tires a pressure of about 26 pounds despite the fact that at this higher pressure much of the cushioning value of the balloon tire is lost and punctures are said to occur oftener because of the higher unit pressure between tire and road. Meanwhile it is well for everybody to note the marked distinction which exists between balloon tires and balloon type tires. As shown by the appended table of approved tire sizes balloon tires are manufactured for wheels and rims of three new and special dimensions only namely 20 21 and 22 inch. Balloon type tires are produced to fit the wheels and rims now in common use. There are now 213 sizes on the approved list of the Rubber Ass n of Am. Proper inflation pressure depends as always on the load but contrary to the former practice the front tires require about five pounds more pressure than the rear tires when the car is empty due to the weight of the engine. A low pressure gage should be used and the inflation uniformly maintained. For ideal comfort in a Lincoln four passenger phaeton for example, 30 pounds front and 25 pounds rear is about right.—*India Rub World*, 69 6, 2 pp

Startling Results from Leather Research were reached by a large number of tests conducted by the Bureau of Standards. These tests have sought to determine the physical properties of leather, especially tearing strength and tensile strength, and much to the surprise of the committee as well as to leather men it has developed that the first and second splits almost invariably are stronger and less easily torn than are the grain leathers now generally employed. It was reported also that at least one leather manufacturer has found it possible to so cure the first and second splits as to make them as soft and pliable as the grain leathers which heretofore have been standard for upholstery purposes and have been more carefully treated because of the higher prices which they command. Another rather startling fact revealed in Mr Herrmann s report was that it is possible to repair cuts and grub holes in upholstery leather in such a way that the repaired portion not only is stronger than the original part but cannot be detected on the finished side even by men with long experience in judging leather qualities.—*Automotive Ind* 50 5, 1 p

Supercharging.—The altitude flights of Lieutenant McCready with a supercharged Liberty engine have focused public attention on supercharging. Supercharging is simply the accomplishment of forcing more gasoline vapor into a cylinder than it could get through normal aspiration. This can be accomplished by true supercharging which consists of forcing an additional charge of vapor into the cylinder at the end of the exhaust stroke, or during the compression stroke of the engine through the medium of a pump or differential piston or by the more usual method of forced induction which uses a blower driving air into the mouth of the carburetor a means of driving the blower and suitable apparatus to compensate for the additional pressure at the mouth of the carburetor in the float chamber and the gasoline pressure line.—*Rudder*

Limousines Exeunt.—Sixteen importers custom body builders and other producers of de luxe cars fittings and accessories exhibited at the annual Automobile Salon which was held simultaneously with the automobile show, at Chicago. If bodies at the salon suggest probable trends in closed car design inside-drive jobs seem likely to replace the former type of limousine. Practically all the town car bodies shown were of the Berline type with dropping glass partition between the driver and the passengers. In many of these bodies efforts have been made to have the glass partition drop entirely out of sight instead of having part of the glass exposed when the window is down.—*Automotive Ind*, 50 6 3 pp ill

Progress Toward 1000 Horsepower Aircraft Engines is the subject of an interesting discussion of highpowered engines in *Aviation* (16 8 3 pp ill). Numerous reports have come from abroad regarding the European development of large bombing engines whereas very little information has been circulated concerning similar developments at home. As a matter of fact our Air Service has been actively engaged in the design and development of large bombing engines ever since the war following the signing of the Armistice. Records show that so far only thirteen airplane engines rated not less than 600 h p have actually been designed and built. Seven are of French design three are British two are American, and one is Italian. As far as can be determined the U S Air Service was therefore without any reliable engine of over 400 h p at the end of the war. During the following year designs were laid down for an eighteen-cylinder W type of 2778 cu in piston displacement known as the model W1. This engine is composed of three rows of six cylinders each, with an included angle of forty degrees between each of the outer rows and vertical row in the center. This arrangement of cylinders probably gives as compact an engine for the displacement as can be produced besides having the features of perfect inertia balance and good evenness of torque delivered to the propeller. The

(Continued on page 342)

Some old timers –working for you

Thomas DeRusha Forty four years service. As a tool maker he has acquired a name for great skill

George E Perlewitz Forty-six years service During all this time he has been building telephone switchboards — and building them better every year

William Miller Forty four years service As a Clerical Chief he has helped to improve our office procedure.

Frank L. Wise. Forty three years service As foreman of several departments, his wide knowledge has been a real contribution to the business.

A L. Salt. Forty three years service. Up from the ranks office boy to Vice-President 1924 President of the Telephone Pioneers.

Fred W Loehr Forty five years service His long experience plays no small part in the quality of Western Electric equipment.

W Merz Forty-two years service. He has served as operative, as foreman and now is Assistant Operating Superintendent.

Lewis J Simon Forty three years service As skilled craftsman and foreman he has served well

MORE than forty years ago these men began their life work with Western Electric Today they are still at it—grown skilled in the service—your service, because they produce the telephones which you use

This record is typical of Western Electric workers. Here men start young, stay young and work long Here they become expert Here they catch the Guild spirit of the "old timers" and carry on that tradition of craftsmanship which has made Western Electric telephones the standard of the world.

R. A Horn Forty-one years service During sixteen of these he has been General Foreman of the insulating division No wonder he is expert!

James Farrell Forty one years service, part of which he has been the efficient foreman of the battery room.

Western Electric

SINCE 1869 MAKERS OF ELECTRICAL EQUIPMENT

Scientific American Digest

(*Continued from page 340*)

first one of these engines was completed near the end of 1920 The rated horsepower was 700 at 1700 r p m, and 750 at 1800 r p m., but the first dynamometer tests showed a much greater output. The original engine except for the occasional substitution of a few new parts completed five fifty hour endurance tests, besides other tests which probably made a total of about 300 hrs running Never before has the first engine built from any design been known to have made such a record nor has any engine of its class been known to complete tests of equal duration The weight of the Model W 1A engine is 1770 lbs and when set to give normally 800 h p, represents 2 21 lb/h p This figure is lower than any of the six more or less successful large engines described above with the exception of the Rolls Royce Condor Modifications which are being tested from time to time, indicate that the weight of this engine can be reduced to less than 1500 lbs without the slightest sacrifice in life and reliability The weight per horsepower would then be 1 87 lb, the lowest value ever obtained for an engine of over 500 h p excluding of course flash readings taken on experimental engines and lower in fact than for the majority of smaller engines The U S Army Air Service now possesses one of the best bombing engines yet developed and the experience which indicates that successful engines of 1000 to 1500 h p can be built to weigh less than 1 5 lb per h p

Air Cleaners.—If one can judge worth by increasing popularity air cleaners have established for themselves a place in the sun, for they are now used as standard equipment on five makes of passenger car This has been brought about in the face of opposition on the part of car makers to any increase in equipment the need for which is not abundantly proved Rapid wear of pistons, rings and cylinders has been a normal condition in automotive engines for many years Since dilution by fuel of crankcase oil has come to be pronounced much of the wear has been laid to the resultant decrease in viscosity of the oil, but there is a growing belief that except under extreme conditions dilution alone is not so serious as has been thought Dilution plus dirt especially road dust containing abrasive material undoubtedly results in rapid wear and there is not the least question that much dirt enters through the carbureter with the charge of air and fuel and is washed onto the bearing surfaces of rings pistons and cylinders So pronounced is its effect in the case of tractors which often must operate in clouds of dust a large part of the time they are in use, that air cleaners are regarded as an absolute necessity With passenger cars and trucks the effect is less only in degree, and since the number of hours use per year generally is much greater than for most tractors the rate of wear may be just as great It is a well known fact that so called carbon deposits in cylinders contain large percentages of silicon from dust inhaled by the engine These deposits are said to be much decreased by the use of air cleaners —*Automotive Ind*

Making Solid Tires from Latex.—In this method substances that combine with or absorb water such as calcium sulphate (calcined gypsum) and other inorganic and organic colloids are added to the latex these substances remain in the finished product, acting as fillers, and do not affect the elasticity of the final product. During over production and consequent cheapness of latex, this method is suitable for the manufacture of solid tires which are fully as cheap as those hitherto made from rubber and are even more durable The procedure described in the patent is as follows The mixture of latex calcium sulfate sulfur and other compounding ingredients is then made up like a batch of concrete and spread firmly on the rim between the plates It is then well tamped a solid rim is attached firmly around the running surface and the latex mixture is allowed to set To improve the strength fibrous materials can also be included in the formula After setting the tire is vulcanized in the usual way then the ring is taken off the plates are removed and the tire is ready for use The entire process is simple it consists in a latex-cementing (or, better, a latex gypsum) treatment of an iron or wood rim The solid tire thus made, however is more durable than those hitherto manufactured, because the latex is coagulated only once, direct to the finished tire, and hence retains all its life.—*Chem and Metal Eng.*

Civil Engineering

Why Italian Dam Failed.—On Dec 1, 1923, a 143 ft power dam at Gleno, Italy, failed suddenly. Great destruction was done by the escaping waters along the valley of the Dezzo River in the 12 mile length down to its junction with the Oglio River at Darfo The Dezzo Valley is steep and narrow and in places the flood wave reached a depth of 100 ft. The loss of life is estimated at 500 The dam, only recently completed was a reinforced-concrete structure of multiple arch type resting on a gravity base of stone masonry It was 143 ft. high above the stream, 863 ft. long on top, and of curved ground plan, comprising a circular central portion about 250 ft. long and straight end portions, tangent to the central curve The reservoir back of the dam was of about 4400 acre ft, or 190,000,000 cu ft. capacity The location is high up in the mountains the highest reservoir level being about 5200 ft above sea level, while Darfo is at 820 ft. No precise statement of the conditions leading up to the break of the dam can be given before the official inquiry is completed Certain facts are fairly well established, however On the authority of a competent engineer of dams who visited the Gleno structure repeatedly, it may be stated that the work was badly executed The masonry of the gravity base was laid up in lime mortar of lime burned near the site by the builders and transported to the dam by cableway The specifications called for cement mortar The gravel aggregate used in the concrete was not washed and the concrete in the structure was porous The reinforcement of the buttresses was scrap netting used during the war for protection against hand grenades. This same engineer stated that during construction one of the arches leaked where a centering timber that projected into the concrete had been cut off flush with the face of the work The reinforced concrete parts of the dam on either side of the masonry base were placed directly on the rock surface, without being trenched into the rock, leaving its end embedded in the concrete Hand mixed concrete was used and the usual precaution of ramming it in the forms was omitted—*Eng News Record* 92 5, 3 pp, ill

Electrical

Ground Currents *from* electric hoisting equipment were the cause of a premature explosion during the sinking of a shaft in West Virginia, which nearly proved fatal to the workmen employed Some of the men refused to work in the shaft unless steam was used in place of electricity for operating the hoist and pumps This was practically out of the question since the electric equipment had already been installed It was decided therefore to make tests to determine the cause of the explosion and to decide upon the remedy The system used for power was grounded on one side and supplied by a 1000-kw rotary converter While the switches were open an electric blasting cap was connected between a pipe in the air line and the discharge line from the pumps The instant a connection was made, the blasting cap detonated It was evident that there was a sufficient difference of potential present in the various places selected to fire blasting caps connected in an ordinary circuit in the shaft. To equalize the voltage at various points around the surface and at the bottom of the shaft, the frames of all the machines on the surface and the pump at the bottom of the shaft were metallically interconnected with a heavy copper conductor and grounded After this work was completed $25 was offered to some of the most intelligent workmen if they could fire an electric blasting cap by connecting it in any way that it would explode without of course using a blasting machine or the power circuit None of them was able to fire a cap in this way—*Coal Age*, 25 7, 1 p, ill

Shrink-fitting a Large Waterwheel by Induction was an interesting solution of the problem of expanding the bucket runner on a 9500 horsepower unit as described in *Elect. World* The over-all diameter of the wheel was 7 ft. 4 in, the diameter of the wheel center 4 ft. 7 in and the length of fit on the shaft 18 in, with step fit of bores 13 006 in and 12.996 in in the present runner The new wheel was put in place on the shaft in the following manner Using available bare stranded wire and insulating by means of sheet and tape asbestos wrapped thereon as required, there were 80 turns placed around the hub and 54 turns around the periphery. These windings were connected in series and supplied with 60-cycle

alternating current through a regulating rheostat from a 87½ kva., 220-volt single-phase transformer The potential across the coils was approximately 103 volts and the current varied from about 135 amp. to 150 amp During the heating the wheel was suspended from the crane and was boxed in to assist in maintaining a uniform temperature throughout Thermometers were placed so that the temperatures of the rim hub interior of the box and room could be observed Upon applying the current it was seen that the hub temperature increased so much more rapidly than the rim temperature that it was advisable to bring up the temperature gradually by applying current for a few minutes at a time allowing the heat to distribute within the box during the intervening few minutes By this process the temperature of the wheel was raised gradually during a period of about 27 hours when the box was removed from the wheel leaving the current on until the wheel was in place on the hub By means of this heating the inside diameter of the hub was increased 0 015 in At the same time the shaft was inclosed with a box packed with ice between the bearing and the wheel location resulting in a reduction in its diameter of about 0 001 in The wheel was readily pulled into place with two rope tackle blocks one on each side moving the crane meanwhile The current was then cut off and the wheel allowed to cool

Transmission Line Work Aided by Aerial Survey is the subject of a description of a new use for the airplane contained in *Eng News Record* (92 9 4 pp ill) Aerial photography was employed to facilitate the rapid completion of two high tension transmission lines 25 and 30 miles in length respectively in the southeastern corner of Pennsylvania The photography for the lines under discussion consisted of contact lines and complete strip maps with special stereoscopic views taken of some of the towns and of some properties to assist in obtaining right of way privileges The average flying elevation was 12 000 ft and the maps were finished on the scale of 1000 ft to the inch A single photograph showed a ground area of about one and one half by two miles There were in the neighborhood of 500 single photographs taken for the line strips A standard biplane driven by a 150 h p motor and capable in calm air of a 6 hour flight at 60 miles an hour was employed in the flying It was equipped with an observer s cockpit in the floor of which an opening was provided for sighting the camera The camera made a picture about 7 by 9½ in in size and used a roll film containing about 100 exposures This brings us down to the point where use of the aerial photographic data actually began The contact prints were studied in connection with the quadrangle maps and a line location laid out on the prints according to the most desirable possibilities of avoiding obstructions high priced land and construction difficulties, also with the idea of accessibility during construction and for future maintenance The prints were then put in the hands of the men securing right of way options With their help the right of way agents located themselves at once on the proposed route and after a little inquiry determined the names of the property owners which were given to the men making searches for descriptions of properties As fast as descriptions were obtained from the county records the property outlines and owners names were inked on the prints When surveying parties were sent out to establish the final alignment and to determine the profile of the route they carried into the field the mosaics with the line route and property lines marked on them and used them throughout the survey

Industrial Progress

A New Casting Process is described in *Automotive Ind* (50 5 ½ p) By this process iron castings are molded and poured with the expenditure of about one eighth of the man hours required by the sand casting methods In addition to this feature the surface hardness which is always present in sand molded castings is absent in the permanent molded castings The iron is much closer grained soft and easily machinable and uniform throughout. The process, which was discussed in *Automotive Industries* of November 1, involves a turntable which carries twelve permanent split type molds The molds are cast iron, being treated when cast so that the interior surfaces are highly refractory In operation, the working surface of the molds are first

coated with amorphous carbon by an acetylene flame. At the next station the dry sand core is set in one half. The mold then closes and continues around to the pouring station, where one man pours the iron from a small ladle. Next the mold opens automatically, the casting is knocked out and the mold is blown out by an air stream ready for the repetition of the cycle. High silicon iron is used and the carbon coating in the interior of the mold reduces the melting point and retards the cooling rate so that the casting forms before the contraction of cooling takes place. The rate and total amount of construction is only about one-fifth of that of the sand casting process. As the surface of the mold is highly refractory and coated with carbon the heat of the incoming metal is conserved and not lost to the mold, which condition causes surface chilling and slower flow. This process is now in operation on Holley carburetor bodies and Ford pistons. About 2500 pistons are produced per day per machine. Experiments have been made with the pouring of malleable iron and several non ferrous metals with very good success. Steel castings can be made by this method providing complicated castings have some cores. The process is not limited to operations on small castings but is even better suited to the production of large castings. Iron castings weighing about 25 lbs have been produced with every degree of success.

Modern Trend in Building Cement Mills.—A development of recent years in the manufacture of Portland cement has been the increasing use of large crushing plants for the preliminary reduction of the rock. There has been much recent discussion in regard to the relative merits of the wet process and the dry process of cement manufacture. Unmistakably the trend during the past five years has been toward the wet process. During this time of 19 plants in the United States constructed or for which machinery contracts have been placed 17 were designed to operate by the wet process. Of the two remaining one while a new plant is an addition to an existing dry process plant. Of several new plants contemplated all or nearly all are to operate by the wet process. Most modern plants have installed kilns from 10 feet to 11 feet in diameter. Two plants in the United States have successfully operated kilns 12 feet in diameter for several years. The limit of the kiln diameter however, seems to have been reached until a better refractory or an improved method of holding lining is obtained. Until the introduction of waste heat boilers the tendency was toward longer kilns but since low temperature kiln gases make the cost of boilers high in proportion to steam produced the recent practice has been to limit the length from 150 to 175 feet when boilers are used. Some wet process plants have installed kilns 240 ft long but no practicable length of kiln will reduce the gases to so low a temperature as a waste heat boiler and economizer. While there have been many important improvements during the past ten years which permit the sale of Portland cement at a relatively lower advance in price than almost any other material used in construction it is probable that the next ten years will see equal improvements. These improvements will probably consist largely of more efficient grinding better economy in fuel consumption more economical use of waste heat and reduced labor charges.—*Cement and Eng News* 36 2 3 pp, ill

The Concrete Stave is a comparatively youthful member of the building unit family. Invented less than 20 years ago its use has been extended to practically every state and community in the country. Soon afterward concrete staves were used in silo construction, their shape making them especially suitable for circular structures. To day, concrete staves are also used in the construction of grain bins coal pockets, barns, hog houses, garages and other buildings. Their most extensive use however is in the construction of silos and coal pockets. In general, the concrete stave is a concrete slab about 30 inches long 10 inches wide and 2½ inches thick. The average weight is around 70 pounds. There is some variation in width and length among the different types of staves that have been developed. Practically all types are of the same thickness. Since the staves are rather large and are set up without mortar rapid speed of construction is possible. A 100 ton silo can ordinarily be completed by three men in two and one-half days' time. This is much quicker than for any other type of

masonry silo The necessary skill required to set up the staves is easily and quickly acquired by the average man with some mechanical ability Soon after the advent of the silo type of coal pocket, these structures were built of concrete staves Coal pockets are almost identical in construction to silos except that they are usually larger and are more heavily reinforced to resist the greater pressure of coal—*Cement and Eng News* 36 2, 4 pp, ill

The Federal Specifications Board has completed the second year of its activity In this the American Engineering Standards Committee has co-operated by obtaining criticisms from the various interested industries of proposed specifications of the Federal Government before the specifications are finally adopted by the board To date the board has adopted approximately 90 specifications and the committee has secured criticism of industry on about the same number From these systematic efforts to bring governmental purchases in line with the best commercial practice important economies both to industry and government are resulting—*Am Gas Jour*

Mechanical Engineering

A New Non torsional Spring—In springs of all usual designs the material is subjected to bending or torsion and their capacity is limited to their volume Any increase in their capacity to absorb energy can be obtained only by means of a corresponding increase in volume, which is however frequently impossible due to lack of available space A change in the nature of the stresses to which the material is subjected is frequently the only way whereby such an increase in capacity can be obtained Due to the fact that pure tension and compression stresses lead to a far more complete utilization of the material spring experts have for a long time been trying to design a spring in which only such stresses occur These efforts have finally led to the invention of the ring spring the first design in which all parts are uniformly subjected to tension or compression stresses The spring consists of inner and outer solid rings which fit into each other along conical surfaces When axial pressure is applied the outer rings are subjected to tensile stresses and the inner rings to compression stresses always within the elastic limit of the material On account of the deformation of the rings which occurs they slip into each other and a spring action in the direction of the longitudinal axis of the spring is obtained An important feature is that the relative motion of the rings is also opposed by a considerable friction between the conical surfaces which materially increases the spring reaction during compression and exerts a retarding action during the recoil at release This property is of particular value in all devices where a great amount of energy must be accumulated and as far as possible consumed—*Am Machinist* 60 7 2 pp ill

What is the Water Circulation in a Boiler?—Ask yourself this question and see how near your answer approaches the real facts as here outlined The wide divergence in opinion as well as the lack of actual information possessed by even those conceded to be the knowing ones in boiler design, was strikingly brought out in a contest Under the terms of the contest the engineer who described correctly the circulation in the horizontal return tubular boiler was to be awarded a prize Hundreds of engineers and engineering associations entered the contest and the variety in answers almost equalled the number of contestants A local of the National Association of Stationary Engineers won the prize the answer which was a composite of its members opinions being practically correct Incidentally some of the members actually constructed a glass model of the boiler before submitting their answer and so were playing a sure shot. Examination of the glass model shows that the water and steam mixture rises up along the front head at a high velocity and after releasing the steam bubbles, the water moves toward the rear until it reaches a point a little beyond the center of the boiler whereupon it drops downward Upon reaching the lower part of the boiler the main part of the stream turns toward the boiler front while a part flows toward the rear There is a secondary steaming zone at the rear head, causing an upward flow, the current then flowing toward the front and downward, making a loop. These two actions cause the circulation of the water to be in the form of a figure 8 placed horizontally—*Power*, 59:8, 2 pp., ill.

General

Zirconium has an exceptionally high melting point, above 4000 degrees Fahrenheit, and it is not attacked by the strongest acids. The perfection of zirconium steel has not yet been reached, but the highest quality of zirconium tool alloy is in daily use in this and other countries In the manufacture of white sanitary ware bathtubs, toilets, cooking utensils, hospital ware washstands, in fact, in every known form of white enamel ware zirconium is now being used as the material that gives the white color and glaze which resists the action of acids, of disease germs, and the corrosion of decaying matter In making electric porcelains zircon is one of the best materials. In airplane and automobile spark plugs, wireless telegraph insulators, high tension transmission insulators, and for similar uses, it is of the greatest value It plays an important part wherever either high temperature or high voltages or both, have to be withstood These qualities also make it desirable as a refractory in fire brick furnace linings, retorts, crucibles and ladles—*Mfr's Record* 85 8 5 pp ill

Hugo Stinnes, the German Industrial Baron.—The concentration of German industry goes on A few weeks ago a new German oil trust was promoted by Hugo Stinnes He combined three important petroleum producers of Germany under his direction The Riebeck'sche Montanwerke the Aktiengesellschaft für Seeschiffahrt und Ueberseehandel and the Aktiengesellschaft für Petroleumindustrie (Api) The Riebeck'sche Montanwerke are important producers of mineral oils and paraffin from bituminous lignites In 1921 22 this company produced 26 000 metric tons of mineral oils and 9700 metric tons of candles paraffin, and mineral wax The output of lignite amounted to 6 300 000 metric tons of tar to 34,273 metric tons The Api was founded in 1896 It owns the famous Bergin patents, methods which make it possible to liquefy coals into oils For this purpose a modern plant with a capacity of 100 000 metric tons yearly was built near Heidelberg The company controls also a great number of refineries storage plants and oil fields in Hanover The Aktiengesellschaft für Seeschiffahrt in Hamburg possesses tank ships storage and distribution plants oil fields in Argentina and controls a number of trading companies Thus this new trust combines the production of coal lignite oil and the refining and distribution of its own and other products—*Eng and Min Journal Press*

Benefits of Moral Support and Capital in Research.—The economies that have resulted from the introduction of the new copper silicon anodes at Chuquicamata, Chile, are such that it may be said that the first phase in the development of that gigantic enterprise has been passed—the perfection of cheap and efficient technical methods for the extraction and recovery of the copper The history of the Chile Copper Co provides many lessons of deep significance to the capitalist, as well as to the non technical observer It shows that the essentials needed for successful achievement comprise unhampered research adequate capital, and moral support It is interesting to note that improvements in technology and economies of operation have been steady but by no means rapid In 1915 the plant operated for seven and one half months and 625 394 tons of ore was treated, with an extraction of only 66 87 per cent In 1916 1 742 748 tons was treated, with an extraction of only 77 15 per cent and it was not until about 18,000,000 tons had been treated and an experience extending over five years or so had been gained that an extraction of 90 per cent was achieved One wonders what would have happened to the Chuquicamata process if it had not been backed by the availability and influence of ample capital if those who were responsible for the inception of the plan had been systematically balked in their demands for adequate research and if enthusiasm had been dampened at the outset and capital diverted in other direction by a verdict based entirely on the opinions of those who were sceptical of ultimate success, or envious of initiative, or both—a verdict that took account of nothing more than the poor metallurgical showing and the comparatively high cost of production at the outset of operations.—*Editorial in Eng and Min Jour Press*

How Much Ash Is Found in Commercial Anthracite?—During the past summer the U S Bureau of Mines took 127 samples of anthracite, each of 1000 pounds, representing nearly 30,000 tons of such coal

in dealers yards in seventeen cities in the State of Massachusetts There were three objects in view To discover the average and the variation in the quantity of ash in anthracite in some easily described area, to demonstrate standard sampling methods and to learn something about the feasibility of itinerant coal sampling The weighted average ash content was For furnace size 13 2 per cent egg 13 7 stove 13 7 chestnut, 16 2 pea 15 6 range 19 buckwheat No 1 18 9 per cent In the eight samples of furnace coal the lowest ash was 10 5 per cent and the highest 14 6 per cent of 20 samples of egg the range was from 10 2 to 17 5 per cent of 20 samples of stove coal 11 3 to 15 9 per cent of 23 samples of chestnut 10 3 to 40 1 per cent of 20 samples of pea 12 to 27 3 per cent of four samples of range 13 1 to 28 per cent of eight samples of No 1 buckwheat, from 13 6 to 29 5 per cent. In the chestnut coal the highest six samples ran 40.1 40 7, 28 3 25 6 18 and 16 5 per cent ash The six cleanest samples ran 10 3 12 2 12 0 13 13 2 and 13 4 per cent ash The coal producer judges the quality of the coal by taking a small sample and by hand separating it into three piles one of coal one of bone and one of slate A piece which he guesses has less than 40 per cent ash would be called coal a piece having from 40 to 65 per cent ash would be called bone and anything having a larger amount of unburnable material would be called slate The figures obtained by this survey give an idea of the actual quantity of ash in anthracite sent to one district in the summer of 1923 when the opinion of dealers was that the quality of the coal in general was good —*Coal Age* 25 8 1 p

Another Attack on the Cotton Boll Weevil has been made by a Georgia grower By increasing the thickness of the hull of the cotton boll through a process of breeding extending over ten years J V Cochran of Marietta Georgia has produced a cotton that practically defies the boll weevil With this cotton, the use of poison has been found necessary only while the stalks are young After the bolls have developed the yield is assured without the further use of poison for the thickness of the hull furnishes full protection to the precious staple inside The idea that the hull of the cotton boll could be made so thick that it could not be penetrated by the boll weevil came to Mr Cochran about ten years ago when he read of the ravages of the pest in the States to the west and realized that it was only a matter of years when the Georgia farmers would be faced by the weevil problem Setting himself to the task of producing a thick bolled cotton he selected three varieties with which he was familiar and planted some of the seed Calcium arsenate was used by Mr Cochran while his cotton was small giving the bolls an opportunity to obtain their growth and then discontinued Other cotton however was practically a total loss when the use of the poison was discontinued at the same time Practically every green boll in the field was literally peppered with holes around the stem the bolls were the only thing in the field that remained green at the time but when a boll was cut open it was found that with rare exceptions the cotton was undamaged Most of the bolls however opened perfectly even though they were perforated at the base all around the stem The weevil had done its best to get through to the lint inside and failed —*Mfrs Record* 85 7 1 p ill

Will Faster Flying Be Dangerous?—Yes says Major L H Bauer Commandant the School of Aviation Medicine in *Aviation* (16 7 2 pp) In making turns, centrifugal force hurls the blood from the brain He also changes the flier's body from vertical to horizontal Continues the author, "Have you ever jumped quickly out of bed and felt dizzy everything in front of your eyes becoming blurred? If so your circulation which was adjusted to the horizontal position in bed did not adjust itself quickly enough to the upright position As a result you had insufficient blood in your brain causing temporary dizziness and faintness This will give you perhaps some idea of how a racing pilot feels as he turns the pylons Centrifugal force pulls on his body and as a result everything in his body that can move does so in the direction of the pull This means that his blood which is of course fluid is carried away from his head into the easily enlarged splanchnic vessels, and even into his legs This means that he has a lack of blood in his brain or what medical men call anemia When we have anemia of the brain we become unconscious. Hence, a flier may become unconscious when making a turn at terrific speed When a man is flying at the rate of four miles per minute it will be seen that making a turn occupies but a moment Anemia of the brain causes faintness and unconsciousness immediately The flier quickly recovers because the circulation rapidly adjusts itself to the new position of the body and the action of the centrifugal force quickly changes to the direction of the new line of travel Is it possible to maintain a speed so great that the anemia produced will be so marked and so prolonged that recovery will not take place? The answer is probably yes We cannot say how great this speed will be Experience only will show However we have another factor not yet mentioned, on which we shall have to figure Dr Garsaux of France made some experiments with dogs He rotated them on a wheel at speeds varying from four to six turns per second Some of the dogs showed actual injury to the brain from the brain being pressed against the skull Recovery followed in some death in others Autopsies showed that there was an anemia of the brain and an engorgement of the vessels of the abdominal area thus bearing out our statements about the aviator It is therefore not a wild theory to presume that a speed may yet be attained which when a turn is made would be sufficient to cause pressure on the stem of the brain in such a manner as to cause death Furthermore the force of such violent action would be sufficient to rupture blood vessels both in the brain and in other parts of the body which in themselves might be sufficient to cause death or lasting injury

Metallurgy

The Alloy Burrowlite is made from nickeliferous ore obtained in the Sudbury district of Ontario In the smelting process the ore is crushed and then treated in a revolving cylinder from which oxygen is excluded and into which a gas containing 80 per cent hydrogen and 10 per cent nitrogen is introduced The ore then is smelted in a crucible or other suitable furnace and scattered on the floor After 24 hours exposure to the air the product disintegrates into a purple colored powder which is further refined and cast into pig form The smelting process requires about four days Properties imparted to steel by the addition of the alloy include toughness great density a high elastic limit and ultimate tensile strength either high or low longation as desired and machinability even when showing a brinell hardness of 300 or more —*Iron Trade Rev*

Alloying Nickel with Cast Iron—Cast iron is emancipating itself from its accepted role of poor cousin to steel and much more care and attention and what is more significant expense is devoted to its manufacture The effect of nickel on iron depends upon the presence and amounts of other elements upon the form of the carbon and other factors The presence of nickel in cast iron causes increased graphitic carbon formation i e nickel tends, as does silicon to gray the iron This effect is quite definite but fairly mild 1 per cent of nickel being equal perhaps roughly to from ¼ to 1 per cent of silicon in this respect The nickel does not form carbides but dissolves in the ferrite of the iron If the composition is such that combined carbon is present in the castings, this will be fine in structure in the presence of from 1 to 5 per cent nickel, and more resembling sorbite than pearlite and in consequence harder Therefore it will be seen that nickel exercises two effects quite opposite in nature by lowering the combined carbon it softens the iron but by sorbitizing the pearlite matrix of the iron it hardens it Which of these will prevail depends largely on the amount of combined carbon If this is low in the composition of iron under consideration i e if the iron is soft and open the nickel will soften it still further If it is high from 0 3 to 0 8 per cent, the hardening effect will predominate as in fact it generally does in practice Grades of gray iron carrying from 0 50 to 0 85 per cent of combined carbon in general will be hardened, strengthened and toughened by the addition of from 1 to 5 per cent of nickel Increases of from 15 to 40 per cent in hardness and in bending or compressive strength are thus obtained The use of nickel often is beneficial particularly in thin sections, in that good values of hardness may be obtained without incurring the risk of obtaining chilled or mottled iron or hard spots The hardness obtained in gray iron by nickel additions is not due to an increase in the amount of carbide present, as it is when

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obtained by lowering the silicon content, with consequent attendant machining difficulties, but is due to the superior and finer form of the pearlite or carbide in the presence of nickel—*Iron Trade Rev* 74 8, 2 pp.

Permalloy has such remarkable magnetic qualities that its use in the manufacture of submarine cables will permit messages to be transmitted at speeds many times that now obtainable, and that is only one of the many applications that this new alloy is sure to find Permalloy is an alloy of nickel and iron characterized by extremely high magnetic permeability at low magnetizing forces Its extraordinary 'magnetic permeability" means the ease with which magnetic lines of force penetrate it and make of it an electro magnet. It is far the most easily magnetized and demagnetized of all metals now known The particular composition which is best in this regard contains about 80 per cent nickel and 20 per cent iron The mere mixture of the two metals is, however not sufficient to secure the highest permeability A special heat treatment is also required When properly heat treated its initial permeability is more than thirty times that of soft iron Another interesting property of nickel iron alloys of about this composition is extreme sensitiveness of magnetic properties to mechanical strain So far as has been determined, however it is only in connection with its magnetic properties that permalloy is unusual. The X ray study of these alloys reveals that their crystal structure is like that of nickel Permalloy can easily be cast in ingots reduced to billets drawn into rods and wire and rolled to thin tape To the engineer the discovery of permalloy will mean the accomplishment of results heretofore believed impossible For the scientist the principal interest in these high nickel iron alloys may well lie in the large response of their magnetic properties to simple external controls Without alteration of composition these properties may be adjusted through extraordinary ranges by strains by magnetization or by heat treatment This allows a more definite study of the way in which these factors are related to magnetic properties than has been possible with materials hitherto available in which their effects are comparatively small and may be associated with complicated and irreversible changes in other properties—*Can Min Jour*

Desulfurization of Coke by Steam, the subject of experimental work conducted by the Department of the Interior and the Carnegie Institute of Technology at the Pittsburgh Experiment Station of the Bureau of Mines has demonstrated that the steaming process effects a greater sulfur removal than is possible with other processes The economic importance of the results of these experiments is that they point the way to future utilization of enormous reserves of high sulfur coals not now suitable for coke making At the present time only low sulfur coals are used for this purpose Sulfur in metallurgical coke gives rise to many problems and difficulties in furnace operations Over 1¼ per cent of sulfur is likely to produce an inferior grade of iron Sulfur will, in addition to causing trouble in the furnace make it difficult, if not impossible to work the iron Any process for removing this deleterious substance from the coke is therefore of value to both the manufacturer and consumer of coke, if the cost is not prohibitive In addition to solving one of the principal problems of the steel industry this removal would create a much greater coal supply from which the coke producer would draw his raw material Many of the coals of Pennsylvania West Virginia and Kentucky are so high in sulfur that their use for the manufacture of metallurgical coke is prohibitive, without preliminary treatment by the present known means of coal cleaning principally coal washing which is not always an effective remedy Illinois has the greatest potential coal supply of any State in the Union with the possible exception of Wyoming, which is underlain by immense fields of low grade subbituminous coal Nearly all of this Illinois coal will make good coke, if not alone, when used in proper mixtures with other coals, but in most cases the sulfur content is above the limit fixed by present standards. Many processes have been tried for the removal of sulfur from coke, including steam, but most of them have not met with any degree of success The investigators at the Bureau of Mines laboratories found that between 10 and 15 per cent of the total sulfur in the coke is removed by simple steaming at 750 degrees C With alternate vacuum and pressure treatment the desulfurisation is increased to 20 to 25 per cent.

New Practice in Metallography.—Two important developments in metallographic analysis have been announced in recent months. One is conical or indirect illumination of the specimen under examination and the other is the effect of very high power magnification Conical illumination, whatever its merits, is a unique development. The results are a truly beautiful picture of the structure of the steel The chief advantage is ability to bring out depressions and elevations in the crystal formation which are entirely indistinguishable by direct illuminating methods More details as to the formation and orientation of crystals, their slip and deformation, and more light on grain boundaries and the effects of certain heat treatment processes are among the likely results As to high power, methods of polishing and etching have been so perfected that, with the aid of certain apparatus and photographic equipment, magnifications up to 9000 diameters have been obtained Those have revealed beautiful crystallisations which throw new light on problems in metal structure and the effect of various hot and cold working processes.—*Iron Age*, 113 ·6.

Steel Made Direct from Ore.—A French patent was issued recently to L P Basset of Paris on his method for making steel directly from iron ore The process consists in subjecting the ore, mixed with the amount of carbon necessary for its reduction and with appropriate fluxes, to the action of a flame obtained by the combustion of powdered coal in the quantity of heated air necessary to insure combustion to carbon monoxide and a small amount of carbon dioxide in such a way that in spite of the slight loss of metal due to the oxidising action of the carbon dioxide (95 instead of 100 per cent reduction) there results an economy due to the diminution in the quantity of powdered coal involved and the easier crushing of the latter On the other hand, the production of carbonic acid which is accompanied by the liberation of 14,550 B t u per pound, as compared with 4450 per pound for carbon monoxide, represents an important saving on fuel.—*Automotive Ind*

Mining

The Greatest Progress in the technique of the cyanide process was made in the application of the well known reaction by which copper and silver may be precipitated from cyanide solutions by acidification The hydrocyanic acid thus set free may be changed back into the form of one of its alkaline salts by the addition of an alkali, or with a greater degree of safety, may be withdrawn by the application of a vacuum and re-dissolved in an alkaline solution An application of the first method is described thus by Harley B Wright Neutral cyanide solutions deprived of free cyanide were treated with sulfuric acid The precipitate, cuprous cyanide was allowed to settle and was filtered after which the solution was made alkaline again by lime and was returned to the circuit. Incidentally, 80 per cent of the gold was precipitated with the copper—*Eng and Min Jour Press*, 117 3.

Electric Wire Safety Lamps.—Flame safety lamps have been available for over a hundred years but during the last ten years safe and practical electric lamps have been perfected Those have eliminated many of the flame safety lamps, and in a few mines have replaced open flame lamps. But there are still more than twice as many open lamps as electric lamps in the mines of the United States all of which the Bureau of Mines declares should be discarded in favor of an approved type of electric lamp There are several electric miners' lamps which have been approved by the Bureau for safety and efficiency which give good light and which are easily maintained and carried Some flame safety lamps will always be used, but mostly for detecting gas, although they might be supplanted if some simple, reliable, and cheap gas detector were developed An open light and gas constitute a vicious hazard, while if there be coal dust present in the vicinity the consequences are multiplied many times. An open light and black blasting powder also constitute an explosion hazard, vividly attested by several serious disasters. Gas is released from the coal formation in numerous ways—by small feeders or blowers in the coal; by falls of roof, by drilling into or blasting vaults, horsebacks, and clay veins, from the floor—

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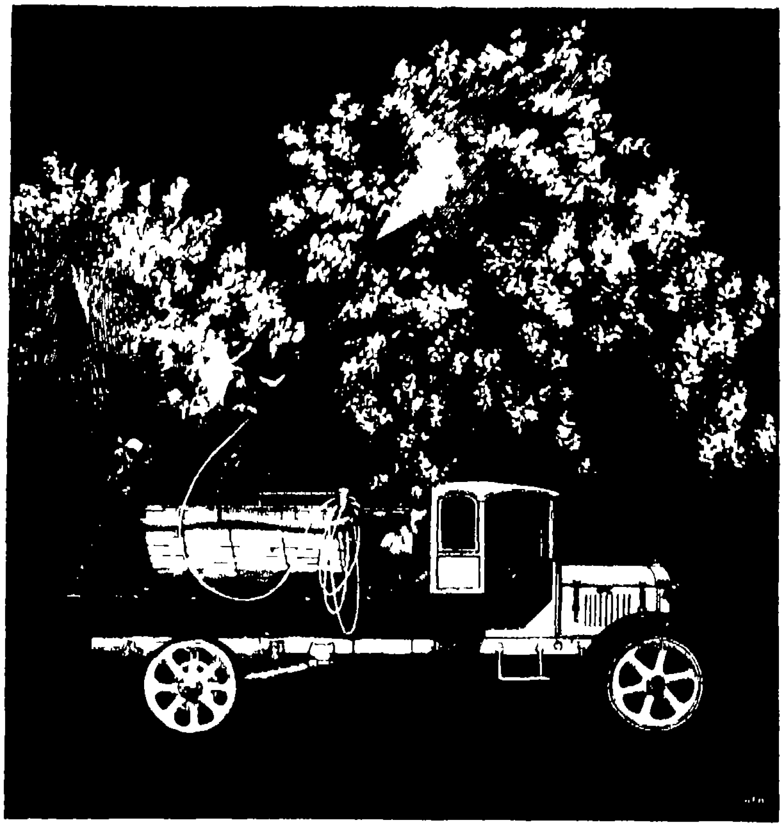

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and in some places may even leak into the workings from a gas well Nobody can say that gas will not be encountered, but it can be said that it may be sooner or later Therefore as a definite safety measure the Bureau of Mines holds that the possibility of a gas release is ever present in coal mines, and that closed lights should be used In other words the open light is unsafe.

Tungsten Steel for Drills.—The *Mining Journal* (London) records an attempt on the Rand to use an extra hard steel of high tungsten content for drilling rock A method has been found of welding the alloy to ordinary drill steel The best ordinary drill steel does not drill more than 15 to 18 ins before it is blunted and loses its gauge, and has to be resharpened The special tungsten steel alloy costs 2s 9d. per lb, against 6½d to 7d per lb for ordinary steel but it is claimed it will drill 48 ins before needing re-sharpening It is proposed to weld a short length of the high cost alloy to the ordinary steel This has been made possible by the introduction of the electric butt welding machine With this machine the two surfaces to be welded are brought together in such a way as to complete an electric circuit, and in the intense heat generated at the junction of the two steels the requisite pressure is applied and the weld is complete With this machine nearly a weld per minute can be made and if these welds will stand up under the repeated percussion of the hammer drill blows in the drill hole there is a possibility of a big advance in technical practice In recent years the annual consumption of rock-drill has averaged £250,000 and even if we deduct the cost of installing electric welding furnaces the gain of having to handle half the weight of drill steel formerly used, both on the surface and underground, and the reduction of sharpening charges will be considerable —*Can Min Jour*

Rubber Linings for Tube Mills—The tube mill is used for breaking up ore Ordinarily they consist of a large tube of metal lined with alloy steel in order that the abrasion of a ton of loose moving and falling ore may cause the least possible amount of wear Strangely enough it has been discovered that rubber forms a better lining for tube mills than steel It lasts longer than steel Says *Canadian Mining Jour* Metallurgists in South Africa have not been slow to take up the new idea The original experiments at Cobalt Ontario stimulated immediate action In Rand practice lumps of the hard abrasive ore are used in the mills in place of the steel balls or rounded pebbles used in Canadian mills These lumps are of course angular with sharp edges and are extremely tough The first step was to place blocks of rubber between the steel liners From this it was determined that vulcanized rubber does not wear as well as soft raw rubber Experiments with the latter are still proceeding and though it is too early to conclude definitely that the soft rubber will replace steel economically it is admitted that so far as the experiments have gone they are distinctly encouraging First cost of the mill is very much higher when lined with rubber but against this added cost is the longer life of the rubber estimated as at least three times that of steel and other advantages such as increased grinding capacity and lower power consumption In Canadian practice a saving in power of 24 per cent has been recorded the rubber lining being only about one eighth the weight of one of steel

A New Prospecting Method.—A novel development campaign by which extensive prospecting is being done with rock drills and sectional drill steel from drifts cross cuts, raises and stopes has been inaugurated by a Utah mining company The new method is proving highly satisfactory as to costs and time required to obtain a given amount of information As the silver lead ores of this mine occur in rather irregular bodies found in three favorable limestone formations, prospecting and development are of first importance That marked economies can be made and much ore located by the new method has been proved and its use is being expanded rapidly The progress made in developing the equipment used is interesting In 1910 a 45 ft. horizontal hole was driven from the top of a raise to connect with and drain the East shaft of a Butte mine The raise being rather small, 2 ft. sections of rod made from 1½ in pipe were used, one piece being welded to a regular drill shank, the remaining sections having

pipe threads on both ends. The necessary sleeves were provided for coupling the rods together as in ordinary pipe fitting, with the exception that the threads were cut to permit the pipe meeting end to end Bit ends were threaded to fit the sleeves The hole was drilled in altered Butte granite and the shaft drained. The Anaconda Copper Mining Co developed the method still further and drilled holes to a depth of 90 ft. through altered granite and gob During the latter part of 1923 the campaign of deep hole prospecting referred to was entered upon and carried out As already stated, the results of this campaign have been satisfactory and the use of the method is being rapidly expanded Normally, 12 miles of development work is done annually in the Chief Consolidated mine, and, as this consists largely of cross-cuts, much of this work can be done by drill holes at a pronounced saving The present equipment conforms closely to that used in standard mine practice and consists of a rock drill, 3 in single screw columns arms and saddle, 1 in air hose, ¾ in water hose, drill bits, threaded drill rods, sleeves and water connection swivel—*Eng and Min Jour Press*, 117 9 2 pp, ill

Railways

Locomotives with Flexible Wheelbase on the Garratt system are being introduced to a considerable extent in Africa and India for narrow gage lines having heavy grades and numerous sharp curves The largest of these engines is a 97 ton locomotive of the 2 8 0-0 8 2 class, built in England recently for the meter gage lines of the Burma Railway and it is the first engine of its type to have eight coupled groups of wheels. In other types of flexible locomotives the main frame extends the full length of the locomotives and is supported on one fixed and one swiveling group of wheels as in the Mallet engine or on two swiveling groups as in the Fairlie engine The Garratt engine however has the boiler carried on a steel deck slung between two trucks with pivot supports on the near ends of the trucks and the cylinders placed at the outer ends Additional adhesion weight is given by tanks and coal bunkers on the tracks In the engine for the Burma Railway the truck bearings are spaced 32 ft. 9 in center to center and the total length is about 70 ft. The two end driving axles and the two groups of eight 39 in driving wheels can adjust themselves independently on curves and the engine is designed to traverse curves of 250 ft. radius. On one truck is a 1500 gal tank and on the other is a 600 gal tank and a 5 ton coal bunker The weight averages 10 tons on each driving axle and 9½ tons on each of the two end axles —*Eng News Record*

Americanizing German Railway Equipment—Bulk freight traffic is an important source of revenue on any railroad and decidedly so in Germany One of the new objectives of the railway administration is to develop the methods of handling this class of traffic to the highest efficiency, and in line with this policy they have gone so far as to contemplate the practical reorganization of the system of handling the commodities. They are following in this respect certain principles which were established long ago in American railway practice Due to a combination of conditions the German railways are putting into service experimentally certain new types of freight car equipment which are a decided advance both as to size and weight and as to improved design over anything which has been in use heretofore The types are of 50 tons capacity, one for bulk freight service and the other a flat bottom car for general service With the introduction of the new rolling equipment, the railroads are also advancing the standards as to track and road bed A heavier rail weighing 49 3 kg per meter and designed to withstand a wheel pressure of 12 5 tons is being laid on the trunk lines. Bridges are being reinforced or rebuilt for 25 tons axle load and eight ton meter longitudinal load, so that a few years hence, those heavier standards will prevail on all the main lines In handling bulk commodities, the feature of automatic unloading presents such obvious economies that its importance can scarcely be over estimated This idea of rapid unloading is applied in the new designs of cars to the handling of commodities such as coal, coke sand, gravel, etc This improvement in German railroad equipment is just another indication of Germany's titanic efforts to gain world mastery in commercial life It is the counterpart of the expansion of German industries since the war —*Railway Rev.*, 74:6, 2 pp., ill.

"This is Station ———"

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short wave transmission coming in to fill the role of the ideal link between "pick up" microphone and broadcasting station. A short wave transmitter located at the very scene of the radio feature, can now be employed to pick up the sounds and transmit them through space at an inaudible frequency so far as receiving sets are concerned to the nearest broadcasting station where the feature is received, amplified and re broadcasted on standard wave lengths for the radio audience and furthermore if this station is a primary broadcasting station, the feature is put on the air at an inaudible or repeating frequency which will have high power to obtain distant transmission This latter wave will be picked up by a chain of repeating stations of the same nature as the Nebraska repeating station of today

There are a good many possible paths in the ether for these repeating waves, so we are assured by radio engineers, and with a sufficient number of properly located high power repeating stations an indefinite number of programs will be made available for the secondary broadcasting stations of low power which will repeat and broadcast at a frequency or wave length audible with the usual receiving sets

The Question of Dollars and Cents

Aside from the solution of several of our present technical troubles the short wave repeating scheme tends to solve the economic phase of broadcasting Long has it been predicted that at some future time many of the independent broadcasters are bound to give up broadcasting in that there are no tangible returns for their efforts and the expenses of broadcasting are steadily mounting higher and higher Then too it seems but a matter of time when our radio entertainers who now give their services so willingly for whatever publicity there may be in broadcasting their efforts will demand remuneration for their services

Please note how this economic phase is met by the short wave transmission from the primary broadcasting station and the repeating stations scattered throughout the country The primary station located in the metropolis is in a position to get the finest talent of the land If the artists must be paid, then the expenses can be distributed among all the repeating stations over a wide expanse of the country Even at the present time the American Telephone & Telegraph Company has such a plan in actual operation Instead of short wave transmission this company, with its splendid network of telephone wires makes use of telephone links to tie up the master studio with the re broadcasting stations In Washington the telephone company maintains a special re-broadcasting station WCAP which handles the same programs as the WEAF station in New York City Then, too the WEAF programs are sent by wire to certain stations in New England which re-broadcast to their local audiences Whatever expense may be connected with the securing of the programs can certainly be apportioned among the various broadcasting stations in such an arrangement thereby tending to solve the great economic question of broadcasting

And at the Receiving End

While the broadcasters are working on the problem of moving the programs up nearer to the listeners in, radio engineers are at work on better and still better receiving sets For let us admit, many of us like radio fishing best of all—this business of seeing how many stations we can pick up in one evening, and how far The author cannot help but indulge in a little reminiscencing at this point. His thoughts go back to those winter days in 1909 when he was working a crude two-slide tuning coil and a crystal detector while trying to pick up the dot and-dash message from Fort Wood which was to tell us how we were coming through with our radio telephone transmission The author fussed and fussed but without success Everything but the desired station could be heard in the head-phones, indeed, even a passing battleship had just called us up with the short but sweet message "For Pete s sake change the tune!" The operator aboard the battleship was referring to our Anvil Chorus, which had just been played for the fifty first time At any rate we finally resorted to the Postal Telegraph wires in the nearby ship-reporting tower then in use at Sandy Hook, as a quick and reliable means of hearing from our collaborators but eighteen miles away

Fifteen years later the author sits before a neat cabinet with two simple dials on which are marked the call letters of various stations, both local and long-distance. The author glances at his watch, it is, two o'clock. Then he looks through the radio program columns of the newspaper—it makes no difference what newspaper, for all newspapers *must* carry the broadcast programs of the day

There is a program in Philadelphia at two o'clock. There is another program in Providence Still another is on the air from Cleveland One New York station is working at this hour Very well. The two handles are turned until the dial pointer indicates the New York station Instantly a violin solo comes out of the flared horn of the loud speaker, standing alongside the long cabinet. The two handles are adjusted for the Philadelphia station, and out comes the voice of a well intentioned lady speaking on some subject or other which has little appeal to masculine tastes. Once more the handles are adjusted until the indicators point to the Providence station Instantly the strains of an orchestra come drifting out of the horn with plenty of volume to fill the room, yet soft and sweet and most lifelike We linger a while, because this feature suits our particular tastes. What a boon, this business of being able to choke off undesirable programs and to select desirable ones! Finally, we set the dials again, this time for Cleveland, only to hear a fair pianist at work

That evening we are going to visit friends—friends who have no radio—odd people these, but perhaps they are not to blame for their sole conception of radio is the squawking loud speaker in front of some cut throat radio shop We take the radio receiver with us, together with the loud speaker That evening our radio receiver is placed on the living room table in the home of our friends We turn the knobs and bring in the President's speech from the banquet table several hundred miles away We dance to the music of a Chicago orchestra We tune in twenty nine separate stations in two hours' time And we sell the idea of radio to our friends before the evening is over

The Rolls-Royce of Radio

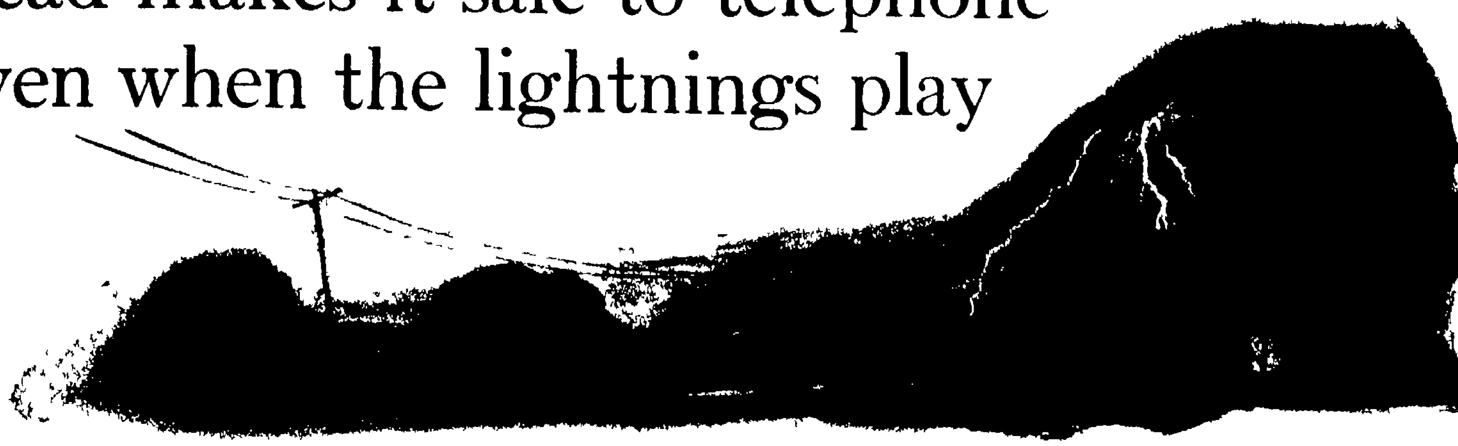
The set in question is entirely self-contained There is no antenna connection No ground wire is necessary Inside the set is a small oblong frame with a dozen turns or so of wire, known as the loop which serves to intercept the radio waves That little loop takes the place of the elevated wire measuring 100 feet or more in length, heretofore required for radio reception Furthermore this set contains a few dry cells to operate the six vacuum tubes The only external connection is that running to the loud speaker And even when the set is being carried about, in the automobile street car, canoe—anywhere, the radio waves from stations several hundred miles away can be intercepted and reproduced good and loud

Of course this particular type of set is admittedly, the 1924 model Rolls Royce of receiving sets It is known as the Armstrong super heterodyne having been developed back in the World War days by Major Armstrong—that same young man who was working on the crude vacuum tube circuits during his college days in 1913. The super heterodyne takes the weak energy intercepted by the small loop, plays it off against a locally generated wave, and the resultant wave is passed through radio frequency amplifiers at high wave lengths, because the so-called untuned radio-frequency amplification is most efficient at high wave lengths, and onto the detector This arrangement makes for the utmost efficiency with simplicity

The advent of special filament vacuum tubes with a consumption of one-quarter ampere in some cases, and even as low as six hundredths of an ampere in others, has made it possible to multiply the number of tubes in individual receivers. Consequently radio engineers have been able to develop new receivers in which four, five and six tubes are employed Whereas the receiving sets first employed in radio broadcasting work intercepted the radio energy and brought it directly to the detector tube which in turn delivered an audio-frequency energy to one or two audio-frequency amplifying tubes to be amplified for very loud headphone or even loud-speaker reception the present day receivers intercept the same amount of radio energy but pass it through one or two stages of what is known as radio frequency amplification, before turning it over to the detector The consequence is

(*Continued on page 358*)

Lead makes it safe to telephone even when the lightnings play



PLAIN gray lead seems a stupid, lumpish metal. Yet when thunder crashes and lightning flashes around your house, that same lead enables you to use your telephone without danger of electrocution. Even if a bolt of lightning strikes the wires while you are talking, lead protects you from harm.

Lead is the principal part of the fuse which is used in the modern telephone system as a protection against unusually heavy electric currents. When a lightning bolt reaches the fuse, it melts the lead of the fuse. This stops the current and prevents it from reaching your instrument.

There are about 76,000,000 fuses in telephone systems in the country, and lead is in them all. More than 27,000 pounds of lead are used every year in renewing burned-out fuses.

A secondary protection

Every telephone line has, in addition to a fuse, a device called a protector. Small particles of lead in these protectors, which are both in the exchange and your end of the telephone line, melt when lightning strikes the line and break the line over which the current is traveling toward you. The amount of lead used in this way is about 1,000,000 pounds. Renewals require the use of about 700,000 pounds more every year.

How lead helps you phone

Lead in fuses is only one of many uses to which this metal is put in the telephone system. Every time you telephone you summon the help of lead. In the telephone instrument and box is an average of 51 soldered connections. Lead is in all of them. Exchanges in the United States and telephone lines running out of them have billions of soldered connections, with about 322,000,000 pounds of lead in them. Changes in connections require the use of about 70,000,000 more pounds of lead every year.

Sheaths of lead

Millions of pounds of lead are necessary to provide snug coverings for telephone cables. One company uses in a year more than 53,000,000 pounds, to cover 35,300,000 feet of cable. Today there are in this country about 82,000 miles of telephone, telegraph, radio and elec-

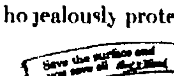
tric light cable covered with lead — 327,300,000 pounds of it. Along this cable are more than 6,000,000 pounds of lead for connecting and sealing the ends of cable to keep out moisture and for terminal boxes.

Where you see lead most

IN telephone systems, you do not see it or realize the important work lead is doing. But in paint, lead in the form of white-lead, the basic lead carbonate, and red-lead, a lead oxide, is known the world over. And after all it is this use of lead that is most universal.

For generations painters have used white-lead on such surfaces as wood and red-lead on metal as standard protection against the assaults of the weather. Rot cannot destroy the house whose surfaces are covered with pure white-lead and pure linseed oil. Rust cannot attack the iron and steel that are thoroughly protected with red-lead.

Property owners who jealously protect their money investments know from experience that



white-lead gives the surest protection for the surfaces of their houses. These owners have learned the truth of the words, "Save the surface and you save all." They realize now that the cost of good paint is secondary to protection of the covered surface.

Producers of lead products

Dutch Boy white-lead is the name of the pure white-lead made and sold by National Lead Company. On every keg of *Dutch Boy white-lead* is reproduced the picture of the Dutch Boy Painter shown below. This trade-mark guarantees a product of the highest quality.

Dutch Boy products also include red-lead, linseed oil, flatting oil, babbitt metals, and solder.

National Lead Company also makes lead products for practically every purpose to which lead can be put in art, industry and daily life. If you want information regarding any particular use of lead write to us.

If you wish to read further about this wonder metal we can tell you of a number of interesting books on the subject. The latest and probably the most complete story of lead and its many uses is "Lead, the Precious Metal," published by the Century Company, New York. If you are unable to get it at your bookstore, write us or the publishers.

NATIONAL LEAD COMPANY

New York, 111 Broadway; Boston, 131 State St.; Buffalo, 116 Oak St.; Chicago, 900 West 18th St.; Cincinnati, 659 Freeman Ave.; Cleveland, 820 West Superior Ave.; St. Louis, 722 Chestnut St.; San Francisco, 485 California St.; Pittsburgh, National Lead & Oil Co. of Pa., 316 Fourth Ave.; Philadelphia, John T. Lewis & Bros. Co., 437 Chestnut St.

Radio Notes

The Invisible Loud-Speaker.—Along with the tendency to place all radio equipment in a fine cabinet so as to find a place for it in the living room, there is a tendency to place the loud speaker in a cabinet. Several of the present offerings are in the form of attractive cabinets, provided with a scroll and screen front. Just as in the case of the modern phonograph it seems almost certain that the awkward loud speaker horn must eventually disappear into a cabinet

Radio Frequency in a Handy Package.—There has lately appeared on the market a vario transformer which simplifies the problem of radio-frequency amplification Instead of having a transformer with fixed windings, this vario-transformer has an adjustment which tunes it accurately for all wave-lengths between 200 and 600 meters Perfect shielding and pig tail connections assure clear tones. Furthermore, the amplification is uniformly maintained through out the broadcasting range This vario transformer is put out as a separate instrument, and also in conjunction with a socket and rheostat, all mounted on a neat base

Keep Matches Away from the Charging Battery!—It is not generally known, unfortunately, that a storage battery on charge is giving off hydrogen gas, and that this gas when mixed with the oxygen of the air forms an explosive For this reason one should keep one's face and lighted matches away from the vent of a battery while it is on charge The small vent of the battery is sufficient to permit the escape of the hydrogen gas, under normal conditions. In the presence of a flame however the hydrogen gas mixed with oxygen may ignite and the battery may very well be blown to pieces One should use an electric flashlight in looking into the charging battery to see the level of the electrolyte in each cell

What Resistance for the Rheostat?—One of the several questions which arise in the construction of a home made receiver is the resistance of the rheostat. There are three general classes of rheostats, so far as resistance rating is concerned Hence it becomes necessary to classify the tubes in three groups in selecting the proper rheostat. A rheostat of 6 ohms is necessary for tubes of 5 volt rating A 20 ohm rheostat is used for the tubes of 3 volt rating A 30-ohm rheostat is used for the 1½ volt tubes As for the carbon rheostats, they may be used with any type of tube since they have a range of resistance from zero to 40 ohms or more thus covering the complete range of resistances

Regeneration and Radio Frequency.—While it is true that the regenerative circuit is making way for the radio frequency circuits, the fact remains that the old regenerative circuit, when properly designed and constructed, gives an amplification equal to between two and three separate stages of radio-frequency amplification Beyond doubt, it is the most economical type of circuit but, unfortunately, in the hands of the inexperienced operator it is allowed to oscillate and therefore becomes a miniature transmitter to annoy the radio audience in the immediate neighborhood When it comes to loud speaker operation the single-circuit regenerative receiver together with two stages of audio frequency amplification gives the best results at the lowest expense It is unfortunate that regenerative sets are in the hands of so many unskilled laymen who have made this otherwise efficient type of receiver a perfect pest to broadcast listeners

The American Telephone & Telegraph Company's Suit against the operators of the local WHN station in New York for the infringement of radio patents, is a matter of considerable concern in radio circles It appears from what has been officially stated by the telephone officials, that the whole purpose of the present suit is to protect the patents of the telephone company which are being infringed with impunity by many broadcasters. On the other hand numerous broadcasters have come forward with the charge that the telephone company is seeking a monopoly of the air, to the end that it may place broadcasting on a strictly commercial basis for its own gain This charge is vigorously denied by the telephone company At the present writing it is unwise to comment one way or the other There is no doubt, of course, that the telephone company's patents are being infringed by hundred of broadcasters. There is no doubt, too, that there are too many broadcasters, especially of the mediocre kind. But whether it is wise for the

telephone company to make the path of the broadcasters still more thorny by charging for the use of patents, remains to be seen, although there can be no question of the legality of such a move.

Tesla and His "Wireless Power."—It is many years since we have heard from Nikola Tesla, the well known electrical inventor and the father of numerous rather startling and fantastic ideas. At the age of 67, Tesla now states that he is on the very threshold of an age which will see the transmission of power over vast distances by means of radio "Since my original experimental demonstration," states Tesla, "I have made great improvements and can now definitely announce that the loss in the transmission to the greatest terrestrial distance, say 12,000 miles, will not amount to more than one-quarter of 1 per cent. This, of course, does not take into account certain unavoidable losses in transmitter and receiver, which will amount to about 4 per cent in the aggregate In conveying energy through wires the loss amounts often to 20 per cent or more, and the distances are limited Such a plant could be put into operation immediately, for I have developed all the details. I shall commence construction in the very near future, relying upon my own resources."

The Transinductor—In the February issue of this journal, under Inventions New and Interesting," there was described the transinductor This new transforming apparatus was designed and invented by Clinton H Hulburt, instead of E. W Kersten as stated in the article One of the latest types of transinductors is applied as a push and pull radio frequency transformer This is the first instance of push and pull radio-frequency amplification Push and pull amplification applied to radio frequency with the use of transinductors is said to overcome distortion, increase amplification and give super-selective tuning In fact it has similar advantages to those of the well-known audio push and pull amplification in audio frequency The push and pull transinductor by means of one dial is capable of controlling the magnetic inductance capacity and iron. It acts as a complete wave length tuner, at maximum efficiency, from 200 to 600 meters. It requires no variable condenser or any other control to bring out super selectivity and sensitiveness in receiving, according to the inventor's claims.

Short-Wave Transmission is now attracting no little attention According to *Wireless Age*, broadcasting stations by means of short wave transmitters, are now able to send their programs over great distances by day as well as by night. This is indicated by the results of short wave broadcasting experiments which have lately reached almost unbelievable results. The feat whereby American broadcasting programs are repeated on these short waves and received and rebroadcasted by English stations, thus reaching the peoples of Great Britain, France, Germany Belgium and the Scandinavian countries, is the outcome of two years' experimenting and perfecting of high frequency apparatus by Frank Conrad, assistant chief engineer of the Westinghouse organization Last October the Westinghouse company inaugurated the first radio repeating station, known as KFKX at Hastings, Nebr This repeating station ever since has been receiving the high frequency wave sent out by the parent station KDKA at East Pittsburg, Pa, simultaneously with the transmission of the usual KDKA broadcast wave One of the most striking things about the short wave transmitting set is the extremely short antenna used The antenna at KDKA for use with the short wave transmitter is slightly in excess of 85 feet, in striking contrast with the 200-foot antenna used for regular broadcasts The great difference in frequency between the short wave broadcasts (under 100 meters) and the common wave length band, approximately 360 meters, can be noted by comparing the kilocycle frequency of two such waves. KDKA commonly transmits to England on a wave length of 94 meters, which is a frequency of 3,200 kilocycles. At the same time KDKA is broadcasting to its regular broadcast audience on a wave length of 326 meters, which is a frequency of 960 kilocycles. Tests have proved that the high frequency broadcasts go farther with the same power input than the ordinary broadcast waves. It has also been proved that daylight has little effect, if any, on this carrying power. These two qualities of the short waves are going to produce a marked effect in the future of broadcasting.

"This is Station ———"

(*Continued from page 354*)

that the weakest radio energy is built up many fold before being turned over to the detector for conversion into audio frequency current. The detector is very much like the trigger of a gun in that a certain amount of force must be applied before it will operate or 'shoot' Thus the weak radio waves may not be strong enough to 'trigger' the detector tube and no amount of audio frequency amplification after the detector will be of any avail if the detector has failed to operate or shoot."

There are all kinds of radio frequency amplifier sets in operation The neutrodyne is perhaps the most popular for aside from its remarkable efficiency it has the marked advantage of being absolutely stable in adjustment. With its three tuning controls once charted for the various stations, the operator of the set can always tune in any desired station by setting the three dials to the numbers indicated on the chart

There are two broad classes of radio frequency amplifiers, namely the tuned radio frequency in which the successive steps or stages are tuned, and the untuned type in which the coupling of one step or stage to the next is accomplished by special transformers of fixed wave length

The old principle of regeneration which makes the detector tube serve as a detector and a radio frequency amplifier at the same time is still found in the latest types of receivers. However, certain precautions are taken so as to prevent the regenerative action of the detector tube from emitting a wave when the regenerative action is forced The combination of so called tuned radio frequency and regeneration is quite popular today

There are receivers in which the vacuum tubes are made to work at two jobs at one time, just as in the regenerative set. Thus in these sets, which are known as reflex sets the same group of tubes are employed first as radio frequency amplifiers and then as audio frequency amplifiers Thus it becomes possible to make a given number of tubes do the work of twice that many when using the conventional methods.

Of radio circuits there is no end Basically however there are about a half-dozen circuits The layman is bound to be confused when confronted with dozens upon dozens of different circuits accompanied by the most fantastic claims Little wonder therefore, that many laymen prefer to hold back from buying their radio set because they have a distinct hunch that the ideal set has not as yet been evolved from the bedlam of receiving circuits. Yet the fact remains that our fundamental circuits of today are highly efficient, and we are not likely to replace them in a hurry

Putting the Atom to Work

(*Continued from page 306*)

electrical, or in other words an etherial property that inertia or massiveness is not due to something in the ultimate unit of matter but to something surrounding it. The observed inertia of an electric charge may be ascribed to the ether which it carries with it But that is too vague and indefinite to be useful It is preferable to say that inertia is explicable in terms of electromagnetism that every electric charge has a certain mass associated with it, and that in an aggregate of electric charges their masses are added together

But here comes the delicate point When electric charges are squeezed close together they interfere with each other to some extent The positive and the negative tend to neutralize each other If they could be jammed into complete coincidence it must be supposed that they would obliterate each other That as far as we know is not possible. But they can approach very near each other And in that case their effect is neutralized as regards distant observation or at least almost neutralized and their inertia is diminished Two opposite charges at a reasonable distance apart will have double the inertia of one But if you pack them too tightly together, the combined inertia will be less than double Some of their mass will apparently have disappeared gone out of existence

Now we said that a helium nucleus if it consisted of four atoms of hydrogen must have those four atoms packed very tightly together There are four positive charges held together with two negative charges and the tight packing would result in a diminished mass a loss of weight, the aggregate will not weigh four times the original unit, but something less In other words, not four

times 1.0077, but only four times 1. That, is the kind of thing to be expected. That would account for the disappearance of the .0077 which belongs to hydrogen isolated, but not to the hydrogen used as the building brick for other atoms. Helium and all the other atoms may be composed of hydrogen but of tightly packed hydrogen. And, accordingly, hydrogen in combination is 1, while hydrogen free is 1.0077.

But this looks as if matter could go out of existence. How is it possible for the seven or eight parts in 10,000 parts of hydrogen to disappear? What about the doctrine of the indestructibility of matter?

But we have never yet said that it left no trace behind. That is just what we have to consider. If matter ever disappears, what are we to expect instead?

Here comes in the theory of relativity which states that in some sort matter and energy are interchangeable. If energy disappeared, we must expect to find generation of matter, and if matter disappeared we must expect to find evolution of energy. Now, so far as we have gone at present, neither of these things has been done in the laboratory. No one has seen matter converted into energy or vice versa. It would be an important day when it was done. But I expect that some day it will be done.

We might stop to ask for a minute how this can possibly be understood. What physical notion can we form of the conversion, or inter-relation, between matter and energy? In my view only through the intervention of the ether. The ether has associated with it an absolute well known though great, velocity—the velocity with which it can transmit waves but which is also, in my belief a constitutional velocity technically called the velocity of light. Parts of the ether which are circulating in vortex or rotational motion with this velocity, are what we must look to for the explanation of the fundamental part of atoms of matter. A whirling structure in a fluid would simulate solid properties and would have an identity of its own as Helmholtz and Lord Kelvin long ago showed. If then this individual circulation is interfered with or opened out, its energy becomes conspicuous. It ceases to be a matter unit and becomes an energy unit.

But the energy of anything moving or circulating with the velocity of light is something portentous. For the energy involves the square of that velocity. And even a grain of dust moving at that speed could do work equal to thousands of foot tons. The energy of one tenth of a milligram the smallest visible or weighable speck moving with the speed of light, equals that of a load 600 tons falling a mile.

If then the whole of any perceptible portion of matter disappeared the energy resulting would be prodigious. When hydrogen is packed into helium the *whole* runs not the slightest risk of disappearing. But seven or eight parts in every 10,000 do disappear. The 1.0077 becomes one. And though the disappearing fraction is small yet the total of which it is a fraction is so gigantic that the result would put all our other sources of energy to shame.

But we have not learned how to pack hydrogen into helium or into any other of the heavier atoms—as yet. No not yet. And yet it would appear that it must have been done, some time and somewhere perhaps in the interior of stars, certainly in ways at present unknown. And, if so some of the energy associated with matter may be accounted for. This is believed to be why the stars are hot. I suggest that some small fraction of this outburst of energy may account for their rapid motion. All the heavenly bodies are moving and all the big ones are hot, roughly speaking. The total energy is beyond anything that can be accounted for by any of the forces known to us, by any except what is here suggested.

Ordinary combustion is due to the packing together of atoms into molecules, a very loose kind of coupling giving a very small amount of energy. The packing of atoms into atoms is a much closer and more violent kind of phenomenon. And the undoing of atoms into non-circulating ether is the most violent of all. The sun is hot enough, but some of the stars are several thousand times hotter. So that the amount of energy confronting us in space is majestic. But there is no difficulty at all in accounting for it on the lines here indicated. And if ever the human race get hold of a means of tapping even a small fraction of the energy contained in the atoms of their own planet, the consequences will be beneficent or destructive according to the state of civilisation at that time attained.

When, Where, Why?

(*Continued from page 312*)

traffic. This is a constructive suggestion for preventing accidents, and one which could not possibly be made in the absence of *complete* figures for *all* the accidents of a whole state, for in the absence of such figures, your guess that most accidents occur to new cars is as good as Commissioner Stoeckel s guess that most occur to old ones

Much discussion goes on, in and out of the daily press, as to just how much reckless driving and reckless walking there is, and just how responsibility for the sum total of automobile accidents should be divided. If you ask this question in New York, again your guess or my guess or anybody s else guess is just as good as that of the Police Commissioner or the head of the city's court system But if you ask it in Connecticut there is no guess-work at all in the answer It will take the Commissioner s office staff about three minutes to find out for you just what percentage of the state's motor accidents are due to recklessness of the operator what percentage to carelessness of a pedestrian what percentages to the carelessness of a contributor (see below), to bad equipment, to carelessness of an occupant of the car, to miscellaneous causes involving no apparent carelessness at all

Under operating recklessness the Connecticut system of tabulation lists twenty one items and it will be interesting to go down this list Intoxication, speed too great for the conditions cutting in, passing a standing trolley passing on curve on hill on wrong side trying to beat a train to the crossing cutting corners parking on the wrong side failure to grant right of way, inattention following the car ahead too closely, runaway car through failure to set brakes, through cranking while in gear confusion skidding careless backing inexperience driving on the wrong side of the road. Pretty complete catalog of the motoring sins is it not? Could you draw up so exhaustive a list of "don'ts without a file of accident reports to refer to?

The pedestrian displays carelessness in seven ways according to the official classification He gets intoxicated he gets confused he plays in the street he steps from behind another vehicle he boards or leaves a trolley improperly he coasts and he crosses the street at a time or place where he shouldn t or without due attention to his course

Contributors whose carelessness aids in bringing on accidents are the motorman the cyclist the teamster, the gateman or flagman the push-cart man the runaway horse the animal of miscellaneous sorts and the unknown operator of another car who succeeded in getting clean away

Defective equipment of course usually means bad brakes glaring headlights or inadequate headlights It may also be the steering gear and tires today are sufficiently reliable to make it reasonable to presume that one that blew out was defective within the possible knowledge of the owner Obscured vision is defective equipment when not due to the rain or snow or fog that is actually in operation at the moment if it is clear you are responsible for being able to see through your own windshield Then there is a miscellaneous category here

The occupant of the car may display carelessness in jumping on or off a moving vehicle in the fact that his very presence there constitutes stealing a ride or in interfering with the operation of the car

Under miscellaneous causes chargeable to nobody in particular are road obstructions weather conditions unprotected railroad crossings, and ignition of the gasoline

Now it is self evident that the very analysis of accidents among this series of causes is a mighty educational undertaking When we can in addition state exactly what percentages of the accidents occurring in a given area within a given time are to be attributed to each cause, we have made a very long step indeed toward prevention We know in what direction to turn legislation, propaganda popular education We know what it is that we are trying to prevent instead of merely guessing In the present article no attempt is made to show what percentages of accidents are due to the various causes we leave that for future treatment. What we are pounding on here is the practical necessity for just such a census of accidents as Connecticut's, based upon just these data—reports of every accident, from those involved

If the figures are available as a means of keeping the bad cars off the road, they are equally available as a means of keeping off the bad drivers. The Commissioner has a file in which are kept, for identification purposes, little index cards showing names, addresses and license numbers of all Connecticut's licensed operators. When the year runs out, these are not destroyed, they are transferred to a permanent file, in which they are arranged alphabetically, and in which appears a complete record of every person who has been licensed to drive in Connecticut since this file was started. Ultimately, of course, it will have to be weeded out up to a certain arbitrary date; but this will not rob it of its value.

The essential details of every accident are entered upon cards of corresponding size to the license cards in this file, but of different styles and colors, and one of these cards is put in the file of each operator involved Trials, suspensions, revocations—everything that constitutes part of one's record on the road—all this goes in In dealing with every accident of today and tomorrow, the Commissioner has available this complete record, he can make it available to the court, or he can avail himself of it by demanding that cause be shown why the license should not be revoked In some jurisdictions you can go right on having the same sort of accidents indefinitely, and none of the old ones will bob up in court to prejudice your showing in the latest one But not so in Connecticut, if you are temperamentally unfitted to drive a car on the public roads, the Commissioner will find you out.

So much for the cause of the accident, the car, the driver There is one other important element, the place Whatever the cause which the judicial sifting-out process hits upon as the proximate one it is usually the case that the physical conditions surrounding the scene of the wreck made some contribution The most reckless driver does not have a smash up every minute, or even a narrow escape his close shaves and his smashes occur at points where there is some physical hazard, however minute, lying in wait for him

Commissioner Stoeckel has formulated a program of identifying these physical hazards and so far as possible eliminating them Large scale maps of the leading cities—New Haven, Bridgeport, Hartford, etc—are posted on his walls, and every time an accident occurs in one of these cities the spot at which it happened is tabbed on the map Ultimately the system may be extended to cover the whole state, already it has been extended to numerous cities which it did not originally cover

For the year s first accident at a given point (usually a corner of course), a triangular headed pin is inserted, carrying the numeral "1" If no further smash comes at that spot during the year the original pin is not disturbed If a second follows the first, the '1' pin is replaced by one of the same shape that says '2" When the roll for a given point reaches six, the shape of the pin changes, and the numerals from "6 upward are carried on square heads. It is then easy enough to pick out the places where accidents are habitual from those where they are not habitual Along toward the end of the year the Commissioner's accident map for one of his cities looks like the picture on page 312

As soon as the accident map makes it clear that accidents are in the habit of coming at a given corner, an inspector is sent out to look that corner over and find its physical defect. If the bulk of the smashes have occurred at night, the illumination is naturally suspect, and he looks for glares or shadows Other suspicious parallelisms between the several accidents at a given spot furnish other leads Sometimes it is one thing sometimes another always the inspector will find out what it is, and usually unless it be pure unadulterated congestion a remedy can be found One of Hartford's plague spots was a five-corners, and the danger was taken out of it by routing all traffic through it circularly Again the prohibition of left hand turns spells remedy Sometimes it may be found that a rough spot in the pavement distracts the driver's attention at the critical moment and renders him peculiarly liable to getting hit, again the combination of grade and intersection may be one calculated to make the uninformed driver lose control temporarily, or there may be a blind spot which can be eliminated.

In one case, the police authorities of a city of some 40,000 were in total ignorance of the existence of the worst trap in the city; when they were informed by the Com

missioner's office that an excessive number of accidents were occurring at this point they laughed and insisted that there must be a mistake There was none, however either in the diagnosis or in the remedy that was applied

There can be no complete elimination of accidents—that should be obvious But just so sure as it is found that accidents keep coming at the *same point* at the rate of four or five or more a year just so surely can a remedy be found There appears no way of learning about the reiterated mishaps, however short of the reporting of all accidents to the proper authorities and the careful recording of the data thus received in substantially the fashion followed in Connecticut. From this angle alone any other branch of the state administration could handle the matter as well as the registration bureau But from all angles combined, it is very clear indeed that in no other way can so much juice be squeezed out of the accident statistics as when these are in charge of the office that registers cars and operators The three functions of registration traffic law enforcement, and collection of data belong naturally together, and they are divorced only at the expense of efficiency They are neglected or omitted only at a still heavier cost. If one of the major avenues of attack upon the traffic problem lies through uniform laws another and equally important one is to be found in the gathering of accident data under a law modeled after that of Connecticut and in an administrator who will model his work after that being done in Connecticut. If this system were *faithfully in force everywhere* the SCIENTIFIC AMERICAN believes that accidents would be reduced at least 25 per cent.

Our Abrams Investigation—VIII

(*Continued from page 313*)

regards it as an improvement on the pathoclast. While both the pathoclast and the machines are emanations from the Abrams machine, nevertheless both have points of difference from it as well as from each other Dr is trying very hard to get out a mechanical diagnostic machine and thinks he is on the way He tells me that he can now throw a vibration into a man which will cancel out his sight and when he takes his hand off the machine his sight immediately returns without any damage

This letter was accompanied by the report of the diagnostician, written on the letter head of his electronic laboratory From the letterhead we gather that this laboratory *aside from its diagnostic and treatment work* by means of electronic reactions also manufactures electronic equipment We quote from the report

The two specimens of handwriting received by you from the Scientific American and forwarded to me have been examined The following is a report of the findings

1 Our case A—Upper 6th right

'2 Our case B—Lower 6th right and lower 6th left.

As you know, I have never been very keen about doing any diagnosing from handwriting as the amount of energy which can be absorbed by the ink is very small in comparison with my method in charging a phial However, even though I have been successful in every localization that I have attempted in this manner, one is apt to make a mistake and I trust that the Scientific American will take this into consideration

From my past experience and experimentation I find that my method is only 80 per cent accurate, which percentage I am sure I could prove in a series of tests I might add that my methods do not embody all of the fantastic claims that have been credited to the work'

Let us analyze the results of this test The diagnostician states that he finds an abscessed condition in our case A's upper 6th right tooth According to the dentist that particular tooth is sound and free from abscess The tooth immediately ahead, however, was *abscessed and therefore removed* At the time the handwriting specimen was taken there was no indication whatsoever that the upper 6th right tooth was infected And if the electronic diagnosis is to be considered as accurate, it should have referred specifically to the second upper right bicuspid, which was the badly infected tooth as already stated.

The diagnostician states that our case B's electronic diagnosis indicates infection in the lower 6th right and lower 6th left. The dentist's report of this case, as already stated, indicates a bad infection of the upper right central and upper left lateral Surely, if the electronic diagnosis were to

be considered reasonably accurate, it should have found those predominant and highly developed sources of infection. The dentist's records show that, contrary to the electronist's findings, the lower 6th year molars were missing

It must be apparent that the electronist has failed to score even a modest success in this diagnostic test. This is rather disappointing in view of the previous correspondence we had with the Los Angeles gentleman reading, in part 'Now as I have said before I know the method will diagnose an abscessed tooth so why not put me to the test. Send me on a specimen of the handwriting on plain white paper and in plain envelope of one or two people whom some dentist will vouch for their having abscessed teeth Use separate envelopes to avoid mixing the vibrations' and let each patient write his own name or anything he pleases, send on to me and I will send you back name of the tooth of each patient. Dr here has always done this stunt correctly and I see no reason why he should fall down with you Not until actually called upon to make a test is there any suggestion of possible failure then this suggestion is put forward quite strongly!

Aside from the obvious failure of the electronist in this particular test, there is another highly significant fact which bears considerable thought. It will be noted that the electronist found the upper 6th right in one case, and the lower 6th right and the lower 6th left in the other In effect, these teeth are all of the same kind Perhaps this is merely a coincidence, but at any rate it is a possibility for which we were quite prepared in advance

A brief review of the records in our co-operating dentist's office disclosed the fact that a very large percentage of dental work is done on the sixth year molars. The dentist's explanation as to the cause for such preponderance of trouble in those specific teeth is that the 6th year molars are the first large teeth in the mouth usually making their appearance at the age of from five to six years Furthermore, our co-operating dentist informs us that in any diagnosis of teeth infections or ailments without a complete examination, he would say offhand that the trouble existed in the 6th year molars

Our Abrams Investigation Committee fails to be impressed by this test of localization In view of the electronist's claim of 80 per cent accuracy in his diagnostic work, we are frankly disappointed As for the small amount of energy derived from handwriting as compared with a blood specimen we can only state that we sent precisely what was asked for Furthermore certain electronic workers have time and again stated that handwriting was as effective as blood specimens

This test must stand as our only evidence of the efficacy of the electronic localization work until other tests are entered into between electronic workers and ourselves Again we solicit electronic workers to co-operate with us in tests to the end that we can arrive at the real truth of the entire electronic controversy

The History of Engineering

THERE comes to hand a most interesting volume the Transactions of the Newcomen Society for the study of the history of engineering and technology This body whose scope is well indicated by the full name quoted has its headquarters in London and the bulk of its membership is British The President of the Society assures us however that they are anxious to have the Society regarded as an international body and that American members would be welcomed most cordially We know of no such body in this country and one whose interests lie in the field of technologic antiquities would find his fees well repaid by the Transactions alone Some idea of the scope of these may be got from a statement of the more important papers included in the volume before us We note discussions of the early history of mechanical handling devices of Greek and Roman engineering instruments of mechanics and engineering from Aristotle to Archimedes, of Timothy Hackworth and the locomotive of Heaton's steam carriage of Gurney's railway locomotives (both of these from 1830) of Brunton's steam horse of 1813, and of several other interesting items In addition there is included in the volume a very useful bibliography of historical subjects and it is the intent to continue this in succeeding volumes until it is brought down to date. The Secretary of the Society is Mr H. W Dickinson, M. I Mech. E., the Science Museum, South Kensington, London S. W 7

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

A New Disinfectant.—According to the *Pharmaceutical Journal* a new disinfectant of excellent properties has appeared on the market under the name of acrosyl. It is both a saponified antiseptic disinfectant and a deodorant. It is a cresol preparation containing 50 per cent tar acids, these acids containing 55 to 60 per cent of meta cresol, which is known to be a more powerful disinfectant than phenol and the other cresols. Irritant properties have been removed from the tar acids during the course of manufacture, and the caustic action of the cresols is reduced by the fatty acids present in the preparation. The carbolic acid coefficient by the Rideal Walker test is three. The odor is particularly pleasant for a preparation of this nature. It is made of a uniform quality, has no corrosive effect on instruments and does not blunt knives.

Colloidal Copper Hydroxide as a Fungicide.—Ordinary Bordeaux mixture, which is commonly used as a fertilizer, has several important disadvantages and defects. For example it does not stick and is liable to scorch. To remove these disadvantages it has been recommended that the colloidal copper compound be used instead of the ordinary substance. This colloidal compound was prepared by the addition of a 10 per cent solution of caustic soda to a solution of sulfate of copper, with constant stirring, any excess of soda being avoided. The precipitated hydrate was repeatedly washed with distilled water by sedimentation. When all the salts were removed, the copper hydrate on shaking with water, gave a colloidal solution which foamed, and contained copper hydrate to the extent of one part in one thousand. It remained in suspension for several weeks. Preliminary tests have indicated that such colloidal copper hydrate in a one to five thousand concentration has excellent sticking properties and is fungicidal to apple scale and blotch.

Linoleum Adhesive Preparations.—It is often desirable to fasten linoleum or oil cloth direct to the floor, which may be wood or cement. The cement that is recommended for this purpose is made in the following manner. Twenty five parts of Venetian turpentine are used as a solvent in which 30 parts of rosin and 70 parts of Manila copal are dissolved. After a homogeneous mixture is obtained which is achieved by heating the substances, it is mixed further with 22 parts of linseed oil. This mixing is accomplished while the first mixture is still hot and on the fire. Then the composition is removed from the fire and 35 parts of denatured alcohol are added. The result is a linoleum adhesive of first rate sticking properties.—*Chemische Umschau*

A New Camphor Substitute.—The laboratories of the Bayer Co. in Germany have produced a new substitute for camphor which bears the name of hexeton. It is said that the effects and properties possessed by hexeton are identical to those of camphor from the qualitative standpoint but that hexeton is approximately twice to four times as powerful as camphor.

Oils from Olive Husks and Grape Stones.—The French journal *Les Matières Grasses* contains a new method for the extraction of oils from olive husks and grape stones. The characteristic features of this method are as follows. In the place of using carbon disulfide, ethylene trichloride is employed because it is not nearly as inflammable as the first named solvent. Furthermore, the solvent power of this substance is almost as great as those of the solvents commonly used for oil extractions. It however possesses the additional advantages that its action is very rapid. The losses in the solvent are only 0.5 to 0.8 liter per hundred kilograms of material treated. The solvent works better at a slightly elevated temperature. The grape stones, and other material that is to be extracted, remain in the extraction apparatus for a period of approximately two hours, which is long enough to remove practically all the oily constituents that they contain. Then the mixture of oil and solvent is sent to the distilling apparatus where the ethylene trichloride is evaporated by the action of dry superheated steam. After the oil is freed from all traces of solvent, it is collected through a suitable draw off cock and the solvent is recovered. The apparatus in the plant consists of a crusher, a dryer for receiving the cake from the crusher, and a boiler which is used for generating the high pressure steam required for the distillation process. Two extractors are necessary, each having a capacity of from 500 to 600 kilograms. A multiple condenser completes the installation. With this apparatus it is possible to extract from 3500 to 4000 kilograms of raw material daily. The condenser requires from 10 to 15 pounds of water per minute. The yield of oil is a little better than 10 per cent of the weight of the cake.

Electro Magnetic Treatment of Steels.—An interesting paper was recently read before the Institution of Production Engineers in London on the subject of the electro magnetic treatment of steels. In this talk it was brought out that in the heat treatment of steel it is not only important to know the temperature of the steel but also the time it has been maintained at that temperature. Steel containing not more than 0.4 per cent of carbon could be hardened perfectly by quenching at a temperature of 750 degrees C. if it had been heated slowly while to obtain similar results with rapid heating a temperature of 810 degrees C. would have to be reached. The point emphasized was that the steel should be heated until its magnetic properties disappeared. It was mentioned that the electro magnetic method of treating steels was applicable, with slight modifications, to a wide range of alloy steels.

Products from Marine Animals.—At a meeting of the American Leather Chemists Association a rather interesting paper was delivered on the products that are obtained from marine animals. The paper dealt particularly with the products that are gained from sharks. It was said that in tropical water sharks that vary in size from two to twenty feet are caught, the average size being ten feet. The most common method used for catching is by the use of gill nets. These are 300 yards long and 12 feet deep and are suspended in the water by buoys and anchors. The small fish are allowed to pass through the net while the large fish are retained. On pulling in the net a blow is delivered by one of the men between the eyes of the shark. It is then hooked in the mouth and hauled on board. A good boat load is 40 sharks, although 100 can be handled. Skinning is done by cutting down the back and working the skin over the sides and belly, any adhering flesh being subsequently removed. The skin is now salted down ready to be sent to the tanners. The liver can now be used for oil recovery, as it contains approximately 50 per cent of oil which for some purposes might replace cod or menhaden oil. The bulk of the flesh is used either as manure or poultry food.

Pimento Seed Oil.—Pimento seed oil is a comparatively new product. The seeds contain approximately from 18 to 19 per cent of oil, which corresponds to forty gallons of oil per ton of seed. It is dark red in color and contains 2 3 per cent of free acids.

Coloring Mature Fruits.—The Bureau of Chemistry has developed a process for coloring mature citrus fruits. This process is now being quite generally employed in California. The use of ethylene displaces entirely the old process of bleaching by means of coal oil burners with or without special humidifying means. In the new method the ethylene is merely forced into the sweat room, and if the room is tight only about one cubic foot of the gas will be needed twice daily for 5000 cubic feet of air space. If the "gassing" is done under canvas, the quantity of ethylene employed is doubled. The coloring, depending on the amount of green color in the fruit, is accomplished usually in two or three days, the maximum being five days and the minimum 1¼ days. The proper temperature for oranges is from 70 to 75 degrees and for lemons from 60 to 65 degrees. The "gassing" has also been done by forcing the ethylene

into cars already loaded Five cubic feet per car per day has been found to do the work. The cost of the bleaching by this process runs from 84 cents to 80 cents per car of fruit This depends however, on the length of time consumed in the bleaching operation as well as on the number of gas applications per car

Paint Plasticity Factors.—The practicability of expressing quantitatively the effects produced upon a paint by long grinding, by changing the concentration of the pigment, by adding soaps, water, mineral oil or deflocculating agents and the like is pointed out by E C Bingham and A. G Jacques in *Industrial and Engineering Chemistry* Since the yield value and mobility are independent properties these factors affect now one of these properties, then the other, and sometimes both simultaneously This independence and the occasionally prodigious magnitude of the effects enhance the importance of the plasticity method Comparative results of experiments are given

New Deposit of Soapstone in Austria.—It is reported that an enormous deposit of soapstone has been discovered in Zwettl, not far from the Bohemian frontier The soapstone, which is stated to require very little preparation, can not only be cut sawn, drilled and polished but will absorb many colors a property that should lead to its extensive use in powder form in the color industry The deposit is the most important of its kind yet discovered in Central Europe

Liquid Oxygen as an Explosive.—Liquid oxygen explosives have been successfully used in Colorado by the Department of the Interior in experimental mine blasting and road construction work at a cost of approximately half that of the gelatin dynamite required to do the same work. A liquid oxygen explosive consists of carbon black, wood pulp or some other carbonaceous material made into cartridges and soaked in liquid oxygen This explosive can be detonated similarly to ordinary dynamite with cap and fuse or with electrical detonators Besides costing less, the liquid oxygen explosive is said to be much safer to use than ordinary dynamite There are disadvantages resulting from its use, however and much is yet to be learned before it can be universally adopted in metal mining

Sulfuric Acid Manufacture.—In *Chemiker Zeitung* 1922, page 699 there is given a short description of a new method of making sulfuric acid in which the chambers are replaced by horizontal cylinders provided with a number of perforated plates. This method is being worked on a practical scale in South Africa The hot sulfurous acid gases first pass through a Glover tower, where they are cooled down to about 80 degrees C and at the same time they increase the acid content of the irrigating acid liquors from 66 per cent to 78 per cent. Then the gases mixed with water vapor, are made to enter the horizontal cylinders at the bottom, meeting a downward current of nitrosyl sulfuric acid Accordingly the acid is freed from its nitrogen content while the sulfur dioxide is converted into sulfuric acid, with resulting increased concentration of the outflowing acid The evolved nitrogen oxide gases are again absorbed in two Gay Lussac towers, connected in series and used further in the process

New German Motor Fuel.—A new German motor fuel, under the name of benzolite has appeared on the market both in Germany and in England This fuel is a patented product and consists of 50 per cent benzol 20 per cent gas oil and 30 per cent of alcohol It is said to be the successor to a preparation known as "tetralit" which was a mixture of benzol and tetralin The new fuel is a water white liquid derived from naphthalene and is of about 0 975 specific gravity at 30 degrees C, flashing at 78 degrees C and of high B T U capacity In practice it is mixed with an equal quantity of petrol or benzol— *Oil Paint and Drug Reporter*, November 12 1923

Use of Water Glass in Paving Streets.—In the city of Locle, Switzerland, according to the *Chemiker Zeitung*, a macadamised road was built in which the sand that was used in making the top surface of the road was first treated with a solution of water glass. About one hundred and twenty liters of ordinary water glass were used per cubic meter of sand It is claimed that the road, made from material treated in this manner, lasted three years. After the application of the top surface the road was well rolled to make it as smooth as possible. Very heavy traffic passed over the road in the three years that it was in use. It was found that the water glass had penetrated to a depth of ten centimeters and had cemented together the particles of sand and dirt into a firm, solid mass for the same depth.

Glycerin as a Seal for Liquefied Hydrogen.—One of the difficulties which the United States Bureau of Standards has encountered in the liquefaction of hydrogen is the securing of hydrogen of sufficient purity If other gases are present, they become frozen at a temperature higher than that at which hydrogen liquefies This clogs up the apparatus and stops the process. The storing of hydrogen in any kind of a gas holder is therefore a matter of some difficulty because gases are very apt to diffuse through the liquid seal used in the holder and become mixed with the hydrogen. Experiments were made during recent months on the relative rates of diffusion of nitrogen through glycerin, machine oil and water It was found that the rate of diffusion through glycerin, is much lower than through water or machine oil This was to be expected because of the extremely low solubilities of nitrogen and other gases in glycerin The Bureau now proposes to employ glycerin as a seal for the gas holder used for the temporary storage of pure hydrogen

Plombit, an Acid Resistant Material.—This is the name given to a product that has recently appeared on the German market The material is in the nature of an artificial asphalt which can be obtained in any desirable color and of higher melting point than is possessed by the ordinary run of asphaltic substances. The melting point of the plombit substance is in the neighborhood of 130 degrees C It is made in a variety of colors and is completely odorless. According to the patent specifications it is a complicated combination of oleic acid with hard rubber plus the addition of concentrated sulfuric acid and free sulfur The new product is of considerable interest to chemists for the substance is perfectly acid proof, as it resists all sorts of acids in varying concentrations and is therefore well suited for lining the walls and bottoms of acid tanks and containers of all sorts, and also for the protection of machinery that is subjected to acid vapors and fumes The process of covering the metal apparatus with the plombit plates is somewhat as follows These sheets which look much like cement or ceramic plates, are dipped into the molten plombit and cemented together so that an even surface free from cracks or openings of any sort is obtained For further details see *Chemiker Zeitung*

Synthetic Marble—A new process of manufacturing synthetic marble has been devised in which the marble is made by a wet method in place of the fire method A mixture is made of chloride of calcium and an aqueous solution of sodium carbonate or a mixture of precipitated carbonate of lime and sodium chloride solution is heated in autoclaves at a temperature of 300 degrees C and 24 atmospheres pressure for a period of eight hours. A compact mass is obtained in this manner The product resembles marble has the same high lustre When sodium sulphate is employed in admixture with chloride of calcium a product is obtained which resembles alabaster—*Chemiker Zeitung*, 1923

Hexalin Soaps.—Hexalin and methylhexalin soaps are being made and used in Germany on a large scale for various textile and laundry purposes The composition of some of these soaps is given below This data was derived from the German periodical called *Seifensieder Zeitung* In the first formula the soap is made from a mixture of 500 parts of linseed oil, 250 to 300 parts of hexalin 199 parts of potash lye of 50 degrees Be, and 1208 parts of water Another formula consisted of 500 parts of rape oil fatty acid, 500 parts of hexalin, 195 parts of potash lye 50 degrees Be., and 1705 parts of water Still another formula consists of 200 parts of cocoanut fat, 130 parts of linseed oil 200 parts of hexalin 156 parts of potash lye and 880 parts of water Products which resemble soft soap are made from the following formula 500 parts of linseed oil, 300 parts of methylhexalin, 100 parts of caustic potash lye, 50 degrees Be, 140 parts of soda lye, 86 degrees Be., and 230 parts of water; 500 parts of linseed oil fatty acid, 300 parts of hexalin, 52 parts of potash lye, 250 parts of soda lye and 300 parts of water These ingredients are mixed together in a kettle heated with indirect steam until a clear solution is obtained. The hydrogenated phenols, hexalin and methylhexalin, aid in the saponification of the fats by the alkali so that the manufacturing process is shortened.

The Story of Steel—V

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the adjoining transformer house to the holders that grip the carbon electrodes. The bottom of the electrodes is maintained with a clear spacing of about three-quarters of an inch between them and the surface of the slag

At the South Chicago Works, the electric furnace is used in conjunction with 25-ton Bessemer converters and large tilting basic open hearth furnaces of 200 tons capacity The capacity of the electric furnace is 25 tons and the charge consists of all blown molten Bessemer metal, or a charge of molten open hearth metal from the 200-ton tilting furnaces is used instead of Bessemer metal Three-phase current is used, and the amperage, automatically regulated, runs from 6000 to 14,000 per phase The current comes in to the transformer house at 2200 volts, and is transformed to 110 volts. If the furnace is producing 80 carbon steel, the temperature will rise to about 2750 degrees if it is making 08 carbon steel, the temperature will rise to 2850, and for certain products it will reach 3000 degrees Fahrenheit

It is needless to say that the perfect control of the temperature at all times, during the process of refining, as well as of the chemical reactions, and the possibility of making many sample tests during the heat, are among the great advantages of electric refining

The sequence of operations in refining a charge of metal, is as follows.

First Twenty five tons of blown molten Bessemer metal or open hearth metal is poured in

Second The electrical current is turned on

Third 1400 pounds of lime, and if Bessemer metal be used, 900 pounds of iron oxide are added This forms a slag for the removal of the phosphorus

Fourth After the phosphorus has been reduced from 09 to 008 of 1 per cent, the preliminary or oxidizing slag is removed from the furnace and a new (reducing) slag is made by shovelling in 1100 pounds of burnt lime 200 pounds of sand 200 pounds of fluorspar and 200 pounds of coke dust—all for the purpose of deoxidizing the metal and eliminating sulfur

Finally when the metal in the charge has been thoroughly refined, the proper amount of manganese, nickel vanadium, chromium, or other alloy is added to produce the alloy steel required The treatment as above described lasts about four and one half hours

In the next chapter of the series we shall deal with the open hearth system by which the bulk of the huge output of steel from our American mills is produced

Exploring Within the Steel

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graphic record is being made, the record is a straight line

When however a discontinuity such as an inclusion, a crack, or a hard or soft spot passes through the solenoid a red light flashes or a bell is rung and the spot of light on the galvanometer scale moves sharply, while the photographic record is no longer a straight line but shows a hump

As applied to an elevator cable supposing that a single wire has been broken, even if the break is inside the cable and is invisible to the eye the defectoscope not only shows that there is a break but it shows exactly where it lies This fact is especially valuable in application to elevator or mine hoist cables that have been in continued use The solenoid can easily be installed around the cable, the control and recording device being located at any desirable place, whether quite remote or not

A highly interesting installation of the defectoscope is now in regular use in Schenectady where it is used for testing the bucket wheels of large steam turbines Some of these forgings are as large as ten feet in diameter and four inches in thickness They must be of unquestioned integrity, for the stresses put upon them by revolving at a high rate of speed are extremely high. By beginning the defectoscopic analysis at the periphery of the disk and moving toward the center in a spiral the analysis is made in much the same manner as if the disk were a single long piece

Since this installation was made two years ago perfect results have been given It is believed that no piece which has been rejected as a result of the magnetic analysis has ever turned out on "autopsy" to be a good disk, and no accepted disk has ever

proved bad in service. Because of microscopic blowholes and other defects which would have remained unknown had it not been for the use of magnetic analysis from ten to twenty per cent of these expensive disks have regularly been thrown out.

In one case this particular instrument indicated a bad spot that seemed to be about the general size and shape of a cigar box However, since the steel from which the forging had been made had a very satisfactory chemical analysis, but for magnetic analysis the disk would have been accepted In fact, so sure were the proponents of the magnetic method that there was a large inclusion of some sort in the large forging that they agreed to repay the cost of the forging if their belief proved inaccurate Therefore the disk was cut open The suspected area was found to contain the fragmented pieces of a broken brick! This brick as illustrating the total depravity of inanimate things, had managed to get into the blooms during the rerolling of the ingot and had been crushed. The pieces were distributed over a considerable area, providing the potential cause for a centrifugal explosion had the disk been used in a turbine

The testing of large circular specimens like car wheels, locomotive tires, fly wheels, large gears and elevator sheaves in a similar manner to that of the turbine disks has also been commercialized

Steel rails were formerly made by the Bessemer process, but it was impossible entirely to eliminate the danger of an occasional batch running a little too high in phosphorus. This element has the effect of causing "cold shortness," or brittleness, especially in cold weather, and many disastrous railway wrecks have resulted from this fact. But rails are now made by the open hearth process and are practically free from this danger They cost more to make but the railroad companies do not hesitate to pay a higher price for them, in fact for two decades they have voluntarily paid a bonus for rails of high standard

In one case a serious wreck was caused by the accidental inclusion of a common bolt which had got into the molten metal in the rail mill and due to some cause which a chemical analysis would have probably shown, had failed to dissolve in it This included bolt had weakened the rail until it broke at the critical moment A simple installation of the defectoscope would have prevented that particular rail from ever leaving the mill

In the Burrows laboratory in Jersey City the writer witnessed one particularly simple but significant demonstration of the defectoscope's ability to 'spot" defects in steel rails A rail that had been in use on a railway during a period of some years was placed in a horizontal position, and a defectoscope was mounted on a movable carriage in such a manner that it was able to traverse the entire length of the rail First it was explained that a well camouflaged artificial flaw' consisting simply of a small hole had previously been drilled into the webb of the rail at some point along its length This had been filled with putty and the job concealed with pigments As the solenoid moved slowly along the length of the rail it was observed that the beam of the galvanometer swung slightly at definite equal intervals of about eighteen inches Then at one point it swung quite sharply left. The latter phenomenon had accurately located the hole, while the former stood as an indication of the strains that had been put upon the steel at the cross ties

As the defectoscope must not be too sensitive for commercial use, and must be able to distinguish between insignificant and serious flaws, it can be adjusted to any desired tolerance in this respect

The magnetoscope unlike the defectoscope does not always give an indication of the existence of flaws. It is used for checking the general physical properties such as hardness, grain size, chemical composition of a piece of steel or iron against the like properties of a standard piece For example, using one of the types of magnetoscope, the magnetic comparator, suppose a certain piece of material is known to possess the exact properties wanted for making a tool and it is desired to know whether these properties have been duplicated in other pieces of material In this case two identical solenoids each having its own system of exploring coils, are provided. In one is placed the standard material, in the other, the material to be checked The two solenoids, energized by alternating current, are connected in series and the test coils are connected in opposition. If the two specimens are not identical in their magnetic properties a differential effect will be measured on an indicating device This is because the voltages set up in the respective test coils are different.

The standard piece may be of any convenient length, while the piece to be tested may be in a continuous length and may be drawn through its coils at any desired speed up to 200 feet per minute The deflections on the indicating device may be read by means of a lamp and scale or they may be made to close the contacts of a delicate relay so that signal lights and bells, or a marking device may be energized

Examination of small circular pieces such as balls ball races rollers, and piston rings by means of the magnetoscope makes the location of cracks, flaws and segregations easy In addition, variations of quenching temperatures of as low as 10 degrees are detectable This method has just been adopted for testing the bevel gear rings of a well known make of motor car

Drills for instance, which have received proper heat treatment are readily separated from imperfect drills and laminated regions in plates can also be determined by means of one form of the magnetoscope

The application of magnetic analysis to irregular shapes must be considered individually, for while the detection of flaws is usually possible, it is not always necessary when the raw stock has been certified magnetically The item of greatest interest in semi finished parts is the correctness of the heat treatment and it is in the sorting out of properly heat treated articles that the application of magnetic analysis to irregular parts and small shapes finds its widest usefulness

Magnetic analysis is also applicable to the study of growing fatigue strains in steel under stress while in service These strains bring about a change in the magnetic qualities of the steel For example, during the life test of a new model automobile, airplane or other machine the model may be dissassembled and the parts examined magnetically, permitting the detection of defective parts before the defect has otherwise made itself discoverable

In short practically three quarters of the steel products of the world are potential subjects of magnetic analysis, and when they have become actual subjects the factor of safety allowed in most steel construction work will according to the proponents of the method, be materially decreased, while the losses due to mysterious failures will greatly diminish

Post-Treaty Standing of the World's Navies

(Continued from page 320)

ment we also show a large predominance with 93 ships In fleet submarines of 1000 tons and over however we make but a poor showing Japan has 24 ships in this class against our six, the eight possessed by Great Britain and nine by France Our position is strong in aircraft carriers and this is due to our conversion of two of our huge battlecruisers 876 feet in length and with a designed speed of 33 knots into aircraft carriers Japan should have come next with three ships in which two battlecruisers were to have been included One of these, however, was injured in the earthquake and a battleship has been converted in its place

We have drawn up this comparison with a view to placing before Congress and the country the urgent need for the construction of at least eight or ten light cruisers of the 8000 to 10 000 tons class The conference permits the arming of such vessels with guns up to eight inch caliber, and a squadron of 10 000 ton, 32 knot vessels, carrying eight of these weapons and with a steaming radius that would enable them to cruise anywhere on the main sea routes of the world together with the construction of a dozen flotilla leaders, would go far to correct the present want of balance in our fleet.

Making High-Tension Cables

(Continued from page 325)

front through a die somewhat larger than its own diameter, the difference being usually about 1/4 or 9/32 inches As the cable passes through this chamber a pressure of 500 pounds per square inch is exerted on the plastic lead by the hydraulically operated piston This pressure forces out an envelope of lead around the paper cable as it passes through the die The reason for having the lead plastic instead of molten is two fold First, because it must not be hot enough to damage the paper or compound and second, because if fluid it would squirt

out all over the place and would not form evenly around the cable, or hold its shape.

Cables, any more than any other kind of electrical apparatus, cannot be delivered without first being tested to make sure that they will give the service for which they were designed In service they must often undergo a considerable amount of bending during the process of installation, they must be able to withstand voltages a good deal in excess of the operating voltage, on account of momentary surges, and all the other electrical characteristics already touched upon must be checked up That means that bending tests, as well as voltage, conductor resistance, insulation resistance, and dielectric loss tests must be made

There are some points about the voltage test which illustrate particularly well how carefully the design of high tension cables has been studied, and necessarily so The duration of excessively high voltage is of importance as it has been found that an insulating material may withstand a very high voltage momentarily but will fail if it is sustained for several minutes. It is also a fact that the kind of voltage has a direct bearing on the strength of the insulating material That is, insulation such as impregnated paper can withstand something like two and a half times the voltage with high tension direct current that it can with 60-cycle alternating current, but with high frequency or oscillating voltage, such as from condenser discharges it fails at about half that voltage Thus in testing care must be taken not to damage the cable by using the wrong kind of voltage, or in operating under service conditions to permit the production of surges, very likely of high frequency by improper switching methods or otherwise.

So it will be seen that it is not a simple matter to convert old ropes and oil refinery refuse into a scientifically designed and perfectly manufactured product, for with high tension cables, where the forces to be controlled are so powerful that they will most certainly search out the slightest weakness, nothing short of perfection will suffice

Truffles and Truffle Hunters

(*Continued from page 332*)

from the common truffles of Europe that they are placed by botanists in a distinct family

The first truffles known to the French were the white summer species *Tuber aestivum*, and the Bourgogne truffle, *Tuber uncinatum* The former soon came to be known as the "English truffle," since it was one of the commonest species in the London markets, being found from midsummer to autumn in beech oak and birch woods It is about as large as a small apple and is covered with conspicuous black warts while the flesh is brownish with white veins The odor is very strong and penetrating and the flavor agreeable

That queen of all the truffles, the Périgord, or *Tuber melanosporum*, was not discovered until about the end of the fifteenth century At the present time, when the French truffle is spoken of this is the kind that is meant. Périgord pie, more commonly known as *Pâté de foies gras*, is flavored with this species, which is famous for its delicate aroma, its uniformly good quality, and its regular shape It is about the size of a walnut, rounded in shape, brown or black externally and ornamented with coarse warts, while the interior is blackish gray variegated with white veins. The odor is very pleasant resembling that of a strawberry when the tubers are young and becoming powerful with age It occurs during the autumn and winter months under oaks and beeches, the live-oak being its favorite shelter tree

The Italian truffle" *T magnatum*, has a strong odor resembling that of garlic or decaying cheese It is quite irregular or lobed in shape without warts, yellowish or brownish yellow externally and pale liver colored veined with white within Although usually the size of a walnut, it sometimes weighs as much as ten or twelve pounds It occurs in late autumn in clayey soil under willows, poplars, or oaks, and rarely in cultivated fields Unfortunately, its flavor does not equal its odor in strength

Another onion-scented species *T macrosporum*, is sometimes found in England beneath oak, beech and willow trees.

One of the characteristic winter species is *Tuber brumale* which is round and black, with sharp warts and the usual variegated flesh Its odor is very strong and lasting

The "white truffle," *T album*, occurs in England, Germany, and southern Sweden, growing half above the ground and half buried. It is about the size of a large walnut and has a whitish red tint.

In the market at Trent, Italy, where I have made careful observations of the edible fungi, the following species are usually found *Tuber aestivum*, *Tuber brumale*, *Tuber mesentericum*, *Tuber melanosporum* and *Tuber uncinatum* In France, several million dollars' worth of truffles are marketed annually at from one to two dollars a pound, many of which find their way to America. In 1913, nearly half a million pounds were exported from France to other countries.

One October day not many years ago, some truffles were sent to our herbarium that were collected under oaks in the suburbs of New York City, with the aid of a dog trained in Italy Two gentlemen had conceived the idea of developing our native truffles and raising dogs to supply the needs of those who wished to hunt them. The idea was a good one—scientifically if not commercially—and we encouraged it. The dog was taken to an adjoining state and found other specimens, which were also sent to us.

Three species of truffles had previously been reported from the eastern United States, but the records were scanty and the specimens few Here were the actual fresh specimens, not many, to be sure but still in sufficient quantity for scientific investigation. Anyone now finding this species can readily recognise it from the description or by comparison with the preserved types. This new species, as published by Miss Gilkey, is yellowish brown, sometimes furrowed, without warts, one-half inch in diameter, yellowish within, marked with white veins. The sacs contain from one to four spores, which are large yellow and beautifully sculptured It occurs in New York, New Jersey, and probably in other eastern states.

The possibility of finding native truffles of commercial importance in this country is rather remote, since they would almost certainly have been discovered already by the French people of the South or the Italians of the North However, there are sections in Virginia and the Carolinas settled by people who probably never saw truffles and it might be well to institute a careful research in those States and in regions lying to the west of them If truffles exist there in abundance, the hogs certainly know it by this time, since it is customary to turn these animals loose in the forests and let them make their own living by hunting acorns and chestnuts and digging up poke root.

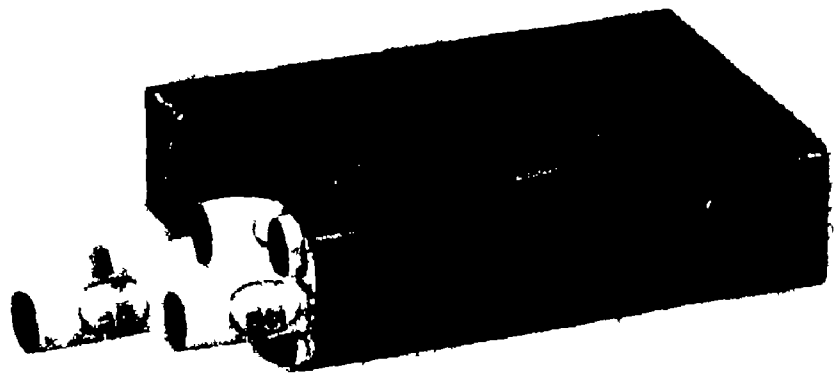
The introduction and cultivation of commercial species would seem perfectly feasible on theoretical grounds, since all the necessary facts and conditions now appear to be known, but careful experimentation alone would determine the accuracy of this conclusion The following conditions would be essential

The *soil* must be light, shaded, properly drained, rich in decaying matter, and containing a certain proportion of lime and clay Sandy soils are too dry and too poor to grow truffles, even if lime were added to them

The *climate* conditions of France and Italy furnish a criterion New York is too cold for the best winter species although some truffles found in northern Europe might grow here. Southern California is probably too dry, but farther north on the Pacific coast there is plenty of rain, as well as moderate temperatures The limestone regions of Virginia and southward would seem to be ideal localities

The best *shelter trees* of Europe are probably the truffle oak, the evergreen oak, and the hazel These and other European species might be planted in this country in places where they would do well, or a number of our native trees and shrubs, such as oaks, beeches, hazelnuts, birches, elms, poplars and willows, might be used experimentally

The *spawning method* most largely used in France for establishing new truffle grounds is to take soil from truffle beds and spread it over the new ground. Another method, called colonising, is to plant mature truffles just as one would plant potatoes, but without the same assurance of success. If there is any virtue in the new method of making artificial cultures on leaves, it would soon appear in a new country where true truffles did not exist. In the case of the ordinary mushroom, excellent spawn may be grown from the flesh of the cap, without using the spores at all. These and other methods might be tried in several well-selected localities in the United States, which, in the event of success, would serve as centers of distribution of the spawn.



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SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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THE WORLD IN MINIATURE MODEL MAKERS AT WORK ON A HUGE RELIEF MAP [See page 394]

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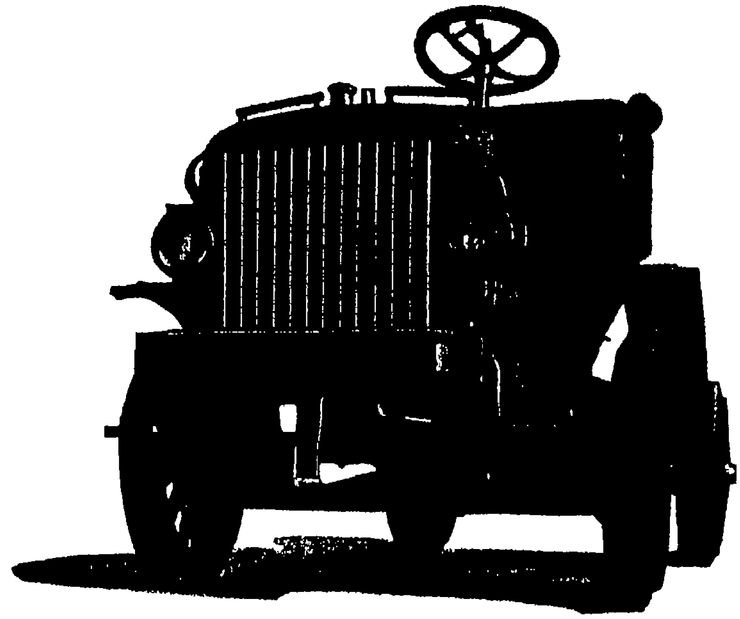
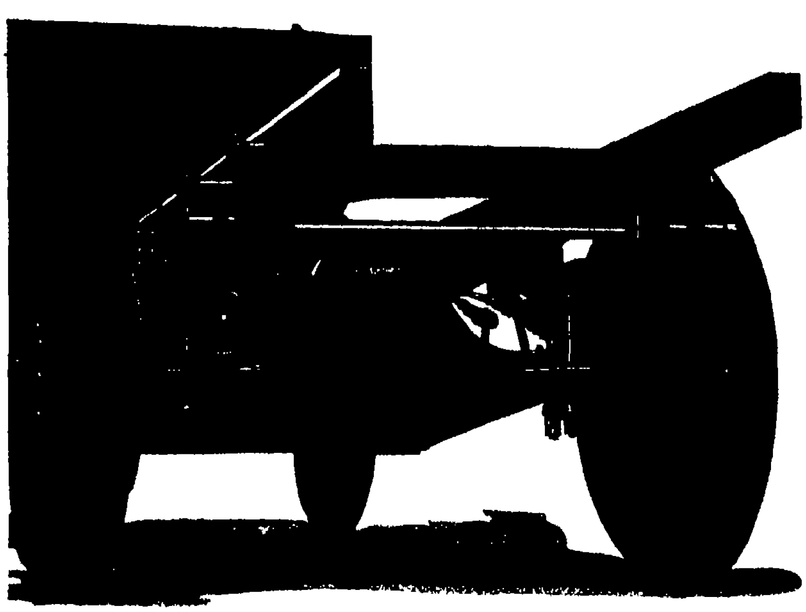
THE SCIENTIFIC AMERICAN, June, 1924 Volume 130 Number 6 Published monthly by Scientific American Publishing Company at 233 Broadway New York N Y and printed in the U S A Subscription price, $4.00 per year Entered as second-class matter June 18 1879 at the post office at New York N Y under the act of March 3 1879





With the Editors

FROM coal tar products to the sky by day; from a study of the earth's crust to fighting the bed bug, from the color in nature to the War Department's radio net, from the safety of life and limb to the handling of snowslides, from the largest map in the world to the rôle of birds in sewage disposal, from the fascinating story of the criminal as an inventive mind to the serious study of fire risks, from Uncle Sam's high priced forestry school to the imposing span of the proposed Sydney Harbor Bridge, from the open hearth furnace of the steel works to the locomotive of the future, from the speculative subject of telepathy to the intricacies of the Abrams technique—all these widely diversified subjects, found in this issue, come within the editorial scope of this journal And this editorial scope continues to expand year by year as new fields are thrown open to science

ALL scientific information is interesting, but perforce some kinds of scientific information are more interesting than others. There is bound to be a more fascinating story in the inventive genius of the criminal than in the compounding of some new paint And after all our object is to be most interesting and always readable, without sacrificing for a single moment the authenticity of the facts thus presented That truth which is stranger than fiction finds expression in our columns, and that truth which is strangest and most interesting finds the greatest amount of space for its proper treatment

THUS many of the happenings in the various fields of science are chronicled in these columns in the form of notes. Lest that vast fund of useful information tucked among the advertisements at the back of every issue be over looked, because of the more readable and obviously more attractive illustrated material, we call attention to it at this time Month after month a member of our staff goes through the current trade papers and technical journals and bulletins which come into our hands in a never-ending flow Those bits of information which are of value to the SCIENTIFIC AMERICAN—that well rounded-out man whose knowledge of practical things makes him sought in the circles of everyday commerce and intellectual social life—are digested into short, understandable abstracts the bulk of which appear under the heading of "The Scientific American Industrial Digest,' while others of a non industrial character are scattered throughout our columns. Professor E G Spaulding of Princeton University, one of our contributing editors, abstracts for us the more interesting articles appearing in domestic and foreign journals devoted to pure science Our Chemical Editor, Mr I Ginsberg, reports new chemical products and processes described in the chemical press of the world in his "Service of the Chemist" department All these abstracts represent far more editorial work than their space allotment would indicate, and they are the very quintessence of information

OUR psychic article for April we must confess, was prepared and published with some misgivings. Would it be possible to say enough without saying too much? Would it be possible to offer additional inducements for high grade mediums to come forward, without making it appear that we were flinging a final challenge into their teeth? Apparently both these things were possible, for in all the comment which we have had from this article nobody who has taken the trouble to write to us has read into our words more than they were intended to convey A sincere regret that we had got no further than we had a sincere determination to do all we could to insure that the last half of our investigation should be less barren of results of permanent scientific value than the first half—that was all we meant to convey and that, judging from the returns is all we did convey

ALREADY we are in a position to insure our readers of action as a result of our enlarged offer Already indeed, we are in the position pictured by the concluding sentences of our April article—that of being obliged to tell all applicants that, for the moment the offer is in a condition of acceptance, and that for the moment no arrangements can be made with further candidates

OUR July issue will contain the first of what we believe will be a fairly extensive series of articles dealing with the mediumship which will come immediately before our committee as a result of our extended offer We have known of the case for some time and have in fact been in rather close touch with it The medium is in every sense of the word a private and non professional one She has never sat save for her family and her friends with the occasional introduction of a small group of privileged investigators She is a person of a social and intellectual and financial standing which make it necessary to appraise the moral factors in the case at a very high value, and to take the claims which are made on her behalf with the greatest seriousness.

THE case has a very considerable history prior to our participation in it, which is so much a part of the story that we plan to tell it at some length Just as in the cases of Nino and his predecessors we had to explain in detail what the mediumship was supposed to consist in, we must do the same for our newest applicant And in her case the story is so much longer must be told in such greater detail, and must have so much more serious attention that we have decided, in the July issue, to attempt nothing more than this We shall by that time have had test sittings but they will have to wait for the August and later issues.

IF YOU have been impatiently skimming these lines in the expectation of learning the identity of this medium whom we take so very seriously you are doomed to disappointment Publicity is the last thing in the world which she wants She will remain anonymous right down to the moment when and if, she wins our money and even after that, if a valid way can be found of making it plain that the case is as represented, her identity will be concealed We shall not even tell you, for the present, where she lives or where our sittings with her are held.

JUST to whet your curiosity a little more sharply, however, we will tell you so much more If she wins our $2500 it is to be devoted entirely to paying the expenses incidental to bringing before us other mediums, for further investigation We shall have more to say of this aspect of the case next month; we mention it here in passing, just to put emphasis upon the financial disinterestedness of the lady who is trying to prove to us that the objective phenomena of the seance room occur

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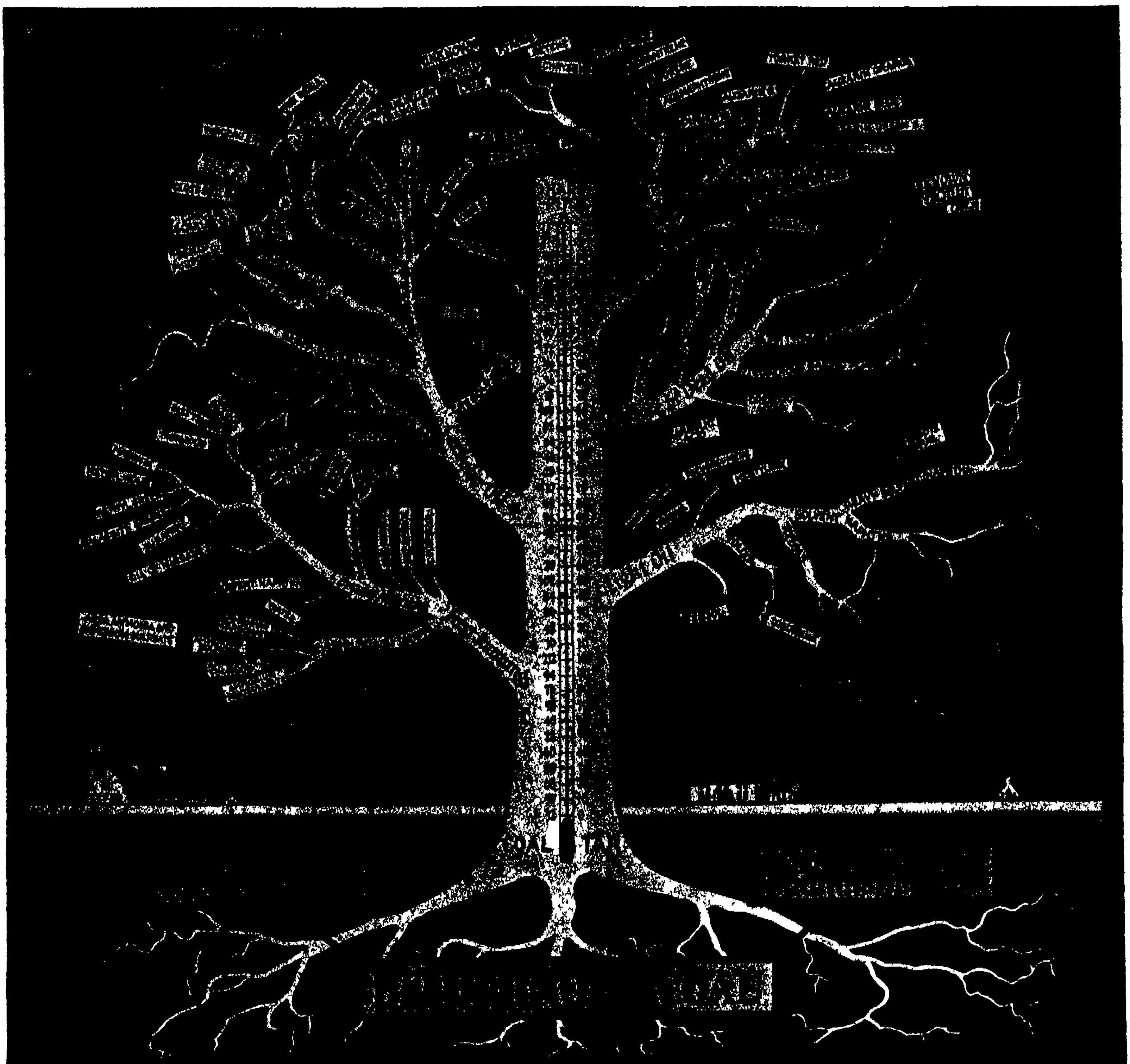
EIGHTIETH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JUNE, 1924



Drawn by our Staff Artist from data supplied by [illegible] Corp.

Delicate perfumes, beautiful dyes, drugs, fire-extinguishing solutions, motor fuels, powerful explosives, fertilizers—these are but a few of the many diversified products based on coal tar, the family tree of which is here shown The thermometer indicates distillation temperature—(See page 390)

Inside the Earth, and Out

Conditions in the Rock Crust That Lead to Earthquakes

By Sir Oliver Lodge, F.R.S.

THE old view about the earth was that it consisted of a thin crust of solid material containing a seething and molten interior which at intervals burst forth in volcanoes and streams of molten lava. At one time indeed exaggerated views were held about the thinness of the solid crust but more conservative estimates placed its thickness at about 800 miles. There was no evidence for this however; the guess was due to the steady increase of temperature experienced as borings were made into the crust, so that it could be reckoned that a temperature that would melt the rocks was to be expected at a reasonable depth.

The idea of a molten or really fluid interior had to be abandoned when the great natural philosophers of the last century began to study with precision the phenomenon of tides. The tides affect only the fluid part of the earth, and practically are found to affect only the ocean, showing that that is really the only fluid portion, in the full sense of the word "fluid." The rest of the earth must be extremely rigid, otherwise the tidal forces would affect that too and the whole earth would bulge, instead of only the liquid ocean at its surface. The yield of the ocean is a differential one. If the whole earth yielded appreciably the extra yield of the ocean as observed, would not occur. Consequently, measurement showed that the earth must be as rigid as glass or steel; and it was also pointed out that rocks under the pressure of the superincumbent materials could not melt, however hot. They have to expand on melting, which is the opposite of ice, and therefore great pressure would keep them solid in spite of high temperature. Moreover it was realised that volcanoes could not be a sign of really deep-seated fire. If the earth were mainly molten, the crust would be likely to break up and sink in and the fluid come to the surface. In fact the earth in a molten stage would not be habitable at all. Ice floats on water but solid rock does not float on molten rock; it sinks.

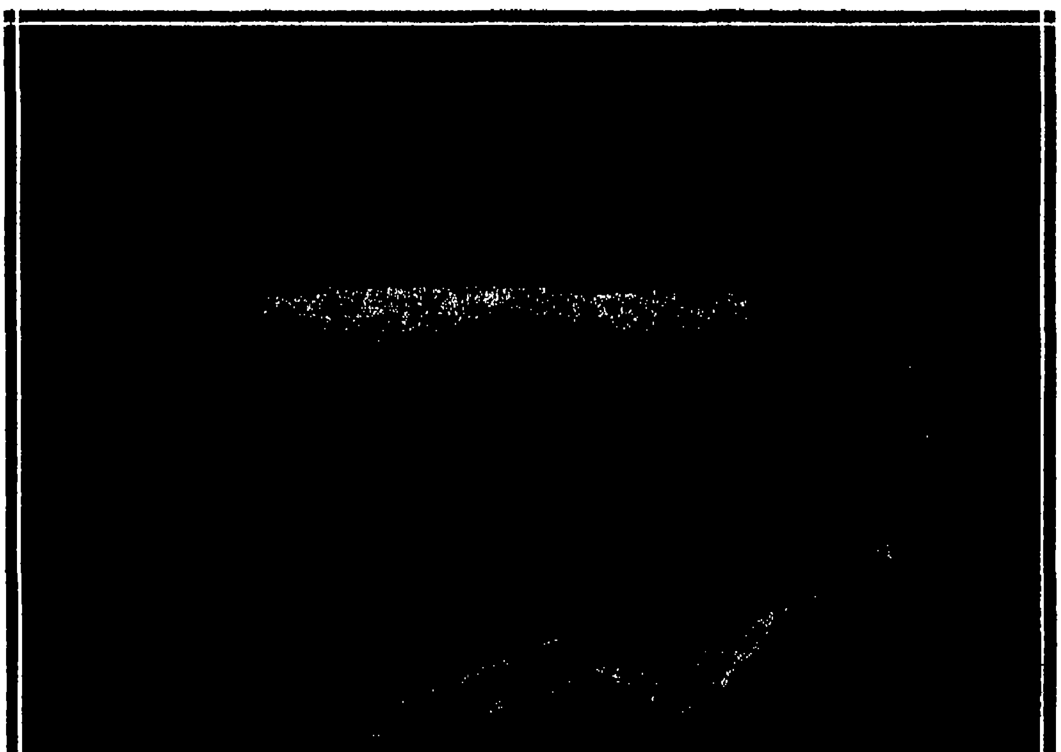
This state of things may really have occurred at a certain early period of the earth's history; but it would not become habitable until this process had all ceased and the crusts formed by cooling had successively fallen in until the whole earth was solid when it would have a chance of cooling at the surface sufficiently to allow water to accumulate and low forms of life to make their appearance; and this cooling has gone on until today. Volcanoes and hot springs were therefore spoken of as mere skin eruptions, localized pockets of heat, which subsequently could be readily explained by radioactivity, that is to say by the spontaneous disintegration of heavy atoms and evolution of some small part of their immense stores of intra atomic energy.

Indeed this phenomenon of radioactivity—which is also held to account for the astonishingly high temperature of the sun and the stars and to be the supply of the heat which they are continually radiating—is so great that the wonder was that the earth was not hotter than it is. Hence no one doubts that the interior of the earth is hot; but everyone doubts that it is seriously fluid. But if not fluid it may be pasty, that is to say extremely viscous. Ordinary viscosity is displayed by such fluids as honey or treacle, but there is a kind of fluidity which behaves like a solid to quick forces and as a fluid only to very slow ones. The most familiar example of that is pitch. Pitch when cold behaves like a brittle solid; it can be broken with a hammer, and does not bend or otherwise yield to ordinary forces. But it is found that if even a small force is applied to it for months together, it yields to that force, very slowly, in the same sort of way that a fluid would yield to it quickly. A fluid takes the shape of any vessel you put it into, and flattens out under its own weight. So does pitch, no matter how cold it is, but you might have to wait several years for the process to be complete. It never yields quickly. A force lasting only a day or two would make hardly any impression, provided it was not sufficient to cause breakage.

Now there is a certain heavy black rock which is rather prevalent in the deep crust of the earth and which when it comes to the surface is known as basalt—the stuff of which the Giant's Causeway, near Portrush in the north of Ireland, is made. This rock becomes plastic and viscous, like sealing wax or pitch, at a reasonably high temperature long before it melts. It contracts on solidifying—that is the reason of the hexagonal clefts in the Giant's Causeway; and, hence, pressure would keep it solid and prevent its melting. It is not, therefore, molten in the ordinary sense even in the hot depths of the earth. It would not yield to tidal forces, which last only for a time measured in hours; but it would yield to forces which continue uniformly to act over centuries or thousands of years.

The modern view, then, of the crust of the earth is that at a certain considerable depth there is a vast accumulation of this semi-plastic material solid and unyielding for all ordinary purposes, but yielding slowly like a fluid to very long continued forces. In this magma the continents are believed to be floating—floating as it were like icebergs in a sea of pitch—solid and stable enough to all appearance, and yet liable to slow and regular movements, of a kind which would be experienced quickly by any ordinary floating body. Some parts might rise, opposite parts might sink; and this sort of slow disturbance is known to be going on. Even in England some parts of the coast are rising so that the sea is retreating; in other parts of the coast the sea is encroaching, or the land is sinking. But the operation is much more striking on a large continent like America. Take South America for instance. It is floating in equilibrium, with a high range of mountains, the Andes, on the west, and the great river plains of Brazil and Argentina on the east, and if left to itself would be in equilibrium, but the rivers keep on carrying down material from the mountains to the sea and hence, though very slowly, are gradually disturbing its balance, like a load shifted from one side of a boat to the other. Consequently it is to be expected that the east side is gradually sinking, and the west side gradually rising—a slow and very slight rotation of the whole continent.

But what is the result? It is evident that a great strain must be put upon the solid materials of the continent especially at the edges. The tilting of a mass like that must be accompanied by sudden fractures and slips. The solid portion will be strained until it gives way and falls suddenly back. Such breakage is most likely to occur where the ground is being forced up. Parts of it will cling on until they can cling no longer and then fall with a smash, and very likely a splash, since the breakage may easily occur under the sea at some little distance from the coast. Hence, it is that the coast near a range of mountains is more likely to be an earthquake region than any portion of a great plain; though of course small slips may occur anywhere, with less frequency.



The photograph taken inside the Kilauea fire pit, showing the flow of lava through a hole in the wall, which Prof. Jaggers got at great risk of his life, after being lowered inside the pit and uncomfortably close to the 2000-degree mass of molten lava. This photograph is, of course, a time exposure

Still more extraordinary consequences have been suggested of late as probably resulting from this flotation theory, which is associated with the name of Professor Wegener, and is called sometimes the Wegener hypothesis. Some of its recent developments are due to Professor John Joly, F.R.S. of Dublin. The moon is known to have been broken or squeezed off from the earth in long past prehistoric ages, and the scar left by its separation is now the mere residuum of a depression called the Pacific Ocean. There was no liquid water or reasonable atmosphere in those very early days, and the earth had no semblance then of what it is now. It was long before the formations which are studied in geology. It must have occurred thousands of millions of years ago. But long after it happened this scar would be deep, and all the water would accumulate there, when water could make its appearance. The great bulge of land would be in the opposite hemisphere, high and dry. But this state of things would not last forever. There would be a tendency for solid matter to fall and move, so as to fill up the cavity. Moreover, a great floating mass of land might break up, and a part of it drift away from the rest. The shape of America looks as if it had once fitted on to Africa and Europe; the idea is that it once formed part of that great continent.

But there are certain propelling forces, partly due to the rotation of the earth—which could be explained more at length—that tend to push a detached mass of land, cracked or separated from the rest by some great convulsion, tend to push it towards the west, in a direction opposite to the rotation of the earth. And thus the floating mass, floating in the viscous magma above spoken of would in the course of ages gradually travel so that water flowed into the interstices or intervening space and became what we now know as the

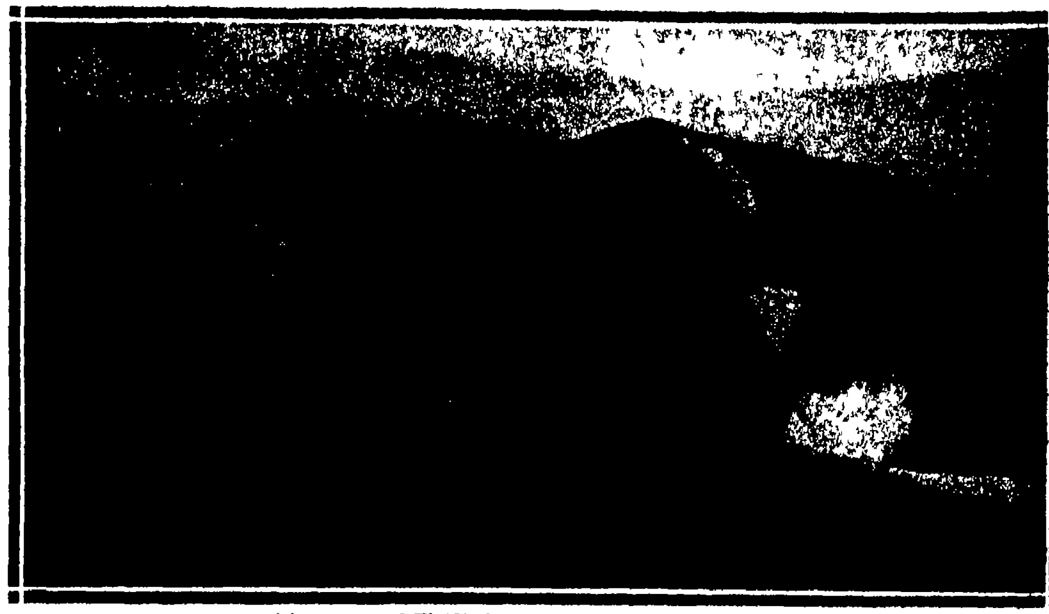
Atlantic Ocean. The pushed continent would tend to crumple up on its advancing side, and would thus form the Rocky Mountains and the Andes, which at one time may have been much higher than they are now, ordinary atmospheric processes of degradation and denudation would wear them down, and a coast line would be formed even on their advancing side, and there would be any number of minor upheavals and sinkings in themselves fairly slow but not slow in comparison with the majestic movement of a whole continent.

On the opposite or eastern side of the earth there would not be the same pushing force tending to separation, but there would be a precipitous descent into the cavity, that is, the lands there would be standing on the edge of a precipice. This would inevitably lead to a certain amount of separation and still more would it lead to occasional cataclysmic disturbances, or breakage and falling in of some portion of the crust.

Anyone living on a mountain side or the edge of a precipice must know that it is rather a dangerous position, and that a landslide may occasionally occur. Japan is situated on just such a precipice. The land slopes down sharply into the depths of the Pacific Ocean, the gradient there being much steeper than on the west coast of America, and accordingly it must be peculiarly liable to the sudden collapses that we call earthquakes. The Philippine Islands are on the edge of another deep chasm.

Now if a breakage of the crust occurs at any place, it is bound to be accompanied by a violent shaking, and this shake or earthquake tremor travels through the rocks at a great pace, giving them a rapid horizontal vibration. The vibration may not be much in extent, it may be only an inch or two. But if the foundations of a house are shaken by a couple of inches by such enormous forces as can shake it rapidly, the brick and stone of the house cannot follow the movement, and the whole structure is liable to collapse. The design of houses in ordinary countries is not adapted to this rapid shaking of the foundations and damage is bound to result. Even a small tremor, much less than an inch, will do serious damage.

When a breakage of the crust occurs under the sea and a cleft is formed, it is quite possible for some water to get into the cleft and descend to regions of high temperature, where it will be converted into steam and may cause something more like a volcanic explosion. There appears no need, however, to call in the aid of steam in order to account for the damage done by a fracture in the earth's crust near an inhabited country. Moreover the shock of the disturbance travels far and wide as an earthquake wave. It travels through the deep-seated rock at a greater pace than through the surface crust, and hence a distant station—it may be a thousand miles away—usually experiences a double shock or double series of vibrations, one set coming through the deep earth itself, another coming through the surface crust a little afterwards. The speed with which these two waves travel is approximately known, and hence by the interval between them, an estimate can be formed of the distance at



The crater of El Misti, 19,260 feet high in the Andes

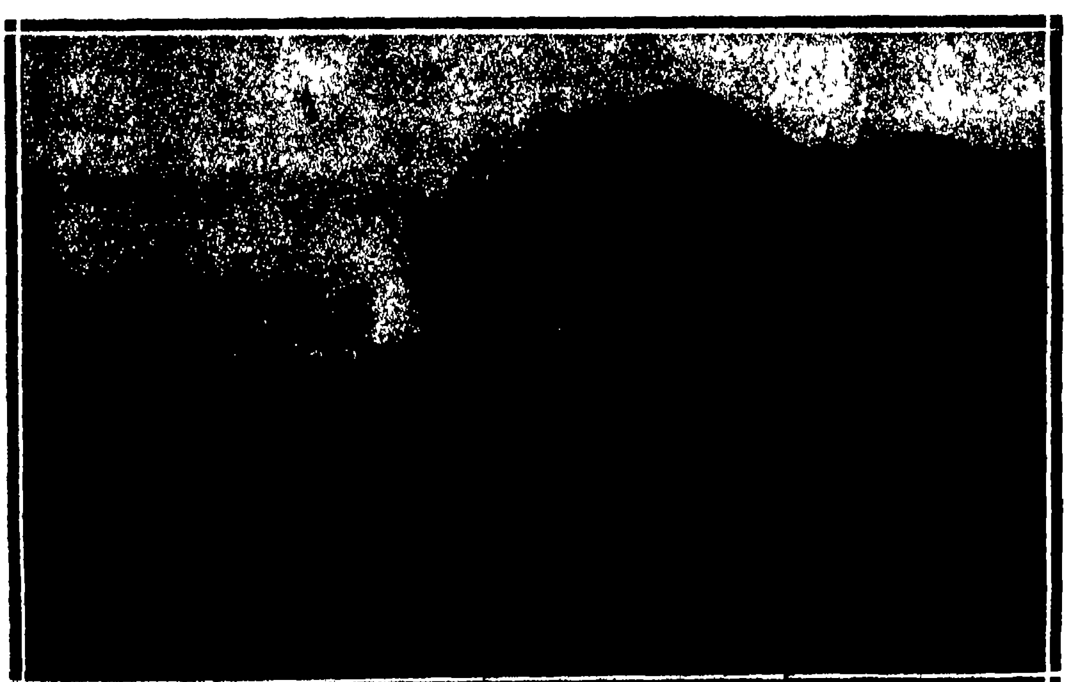
which the original catastrophe must have occurred.

If two people go to opposite ends of a long iron railing, and one of them hits the rail, the other can adjust himself so as to hear two knocks, one coming through the iron, the other through the air, the speed of sound in iron being four times that through air, and by timing these sounds he could reckon how far away the person was who delivered the blow, even if he did not know. If he were listening in the middle of a long railing running east and west he might be uncertain whether the sound came from the east or from the west; to tell that, he would have to compare notes with other observers. But if there were two listeners with a little distance between them, then either of them could tell the distance, and both of them together could tell the direction, for the nearer one would receive the wave before the other.

To imitate the condition of an earthquake observer we might imagine railings running north, south, east, and west. Then suppose two observers both on the east and west line get the shock simultaneously—they would know that it must be coming from the north or the south; whereas, if one received the sound before the other, say the more easterly one, they would know that it was coming partly from the east. But to localize it with any precision more than two observers would be necessary. They must have instruments which would record the accurate time of the shock and they must telegraph the results to each other. Roughly speaking that is how it is done. It is somewhat akin to the sound ranging by which guns were localized during the war by timing the arrival of the sound at different stations.

The earthquake wave is not a sound in the ordinary sense, though it travels with the speed of sound in the different materials through which it comes. It is a quiver which has to be registered by ingeniously devised pendulum instruments, some of which we owe to the great earthquake observer, the late John Milne, who spent many years in Japan, and some of which we owe to Sir Alfred Ewing, now Principal of the University of Edinburgh. Many observing stations equipped with these delicate and ingenious instruments, are distributed in nearly all civilized countries.

The above is a cold-blooded account or summary of the immense amount of knowledge that has now been acquired about the crust of the earth in the past and present, and the wonder is that the earth is as stable and habitable as it is. But it is not really stable, and we are wakened up to the fact of insecurity every now and then by one of these cataclysms which, though small and insignificant from the cosmic point of view, have a terrible effect upon humanity. Man is a mere pigmy among these convulsions of nature; he is a child of nature, a child of the earth, as we might say, and must suffer for the storms and immaturity of his parent. It is all good and wholesome for us in the long run, however dreadful it seems at the time, and at any rate we may be thankful that the distress and loss of life has not this time been brought about by human wickedness. Man is not responsible. And under those circumstances, though we are horrified, we need not be unduly distressed or depressed. A world wide calamity that destroys whole families is, I expect, less heart rending than one which picks out here one and there another. An earthquake destroys indiscriminately, it does not select the young and vigorous for destruction; indeed they are more likely than others to escape. In nature there is a survival of the fittest. In war there is a destruction of the fittest. The longing to help and the sympathy which is called out by an earthquake cataclysm are all to the good. These occurrences are part of the mystery of life and death. We are not responsible for them; we must do what we can to help, and retain our trust in the wisdom and beneficence of Higher Powers.

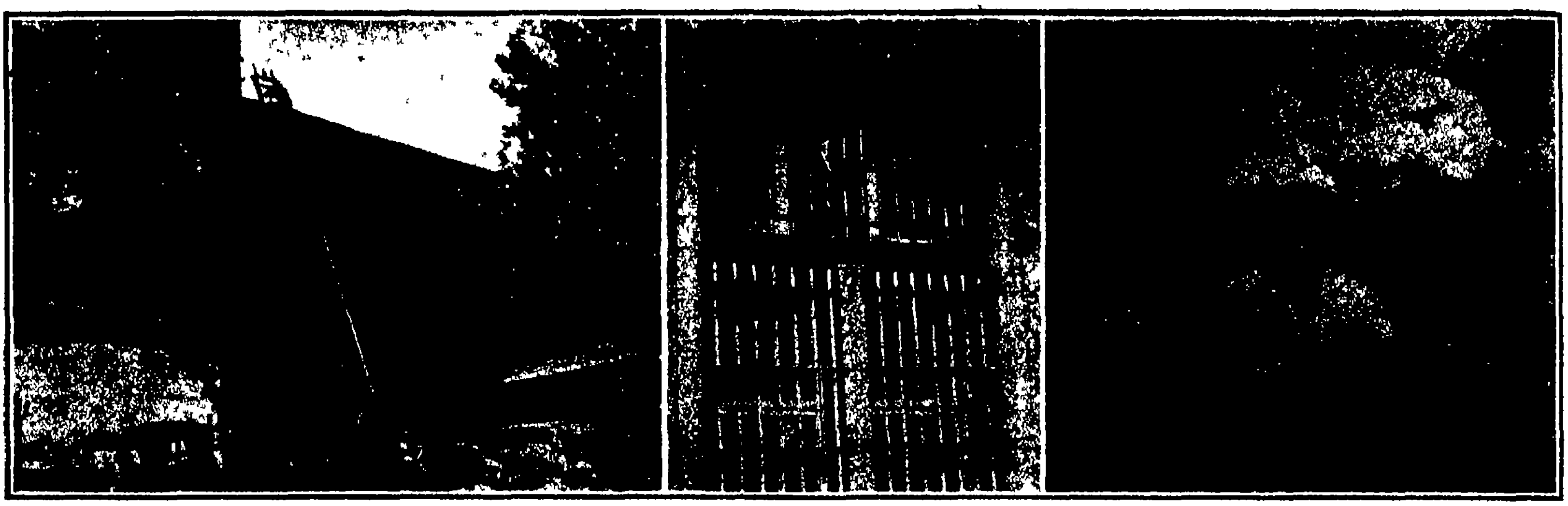


Group of five live craters in Java, Smerve at the top and Bromo below being active at the moment, while the other three are temporarily quiescent

Photographs of the Inner Body

ACCORDING to the report of the Paris representative of the American Medical Association, Drs. A. Kotzareff and L. Weyl, by the use of radium emanation added to blood serum, have been able to obtain photographs of cancers inside the body. The new method involves withdrawing from the body a certain amount of blood. From this blood the serum is obtained. To this blood serum a definite dosage of radium emanation is added. The radium treated blood serum is then injected into the body. The radium emanations tend to locate in the most rapidly growing tissues, such as tumors of a malignant character like cancer. When a photograph of the body is made, the presence of the radium emanation manifests itself on the photographic plate.

When this method was applied to a pregnant guinea pig it was found that after a certain period of time the radium emanations concentrated in the embryo



Left Fire ladders etc being used to study the point of departure of a group of escaped criminals and incidentally to demonstrate the height of the wall which they had scaled with home-made rope ladders. *Center* The irregularity in the pickets at the top of this picture is not very conspicuous but made with an improvised crowbar it was sufficient for the escape of two men *Right* The outer terminus of the tunnel that carried several industrious residents of Atlanta into a more congenial atmosphere

Interesting escapes that have involved inventive ability on the part of those who engineered them

The Criminal as an Inventor

Some Curious Contrivances of the Oblique Mind that Have No Prototype in Legitimate Technology

By Edward H Smith

ABOUT the year 550 the Emperor Justinian turned smuggler Somewhat earlier when the prodigal Theodora was still alive and alight he had allowed himself to become enmeshed in silk Whether, as our romantics will have it this was merely another loverly indulgence to gratify the roving opulence of his gutter born imperatrix or an astute bit of statecraft aimed at a Persian monopoly, we cannot determine at this pathetic distance In either event, the most celebrated member of the Byzantine line did become interested in sericulture and, by that token a common criminal

Silk had been reaching Europe since before the Christian era from China in the caravans of the traders of Iran The first came to Greece from Cos in the shape of a tissue so fine that it revealed rather than clothed the form Later the raw product began to reach Rome, where it was more valuable than its weight in gold Always it had been carried west by the Persian merchants, who were said to have gleaned enormous profits from the traffic

But nothing came to Europe except the fiber or the woven tissues of the east and silk remained a mysterious even a fabulous stuff wherein shone the moonlight of great deserts and the spilt blood of swart alien men So for most a thousand years

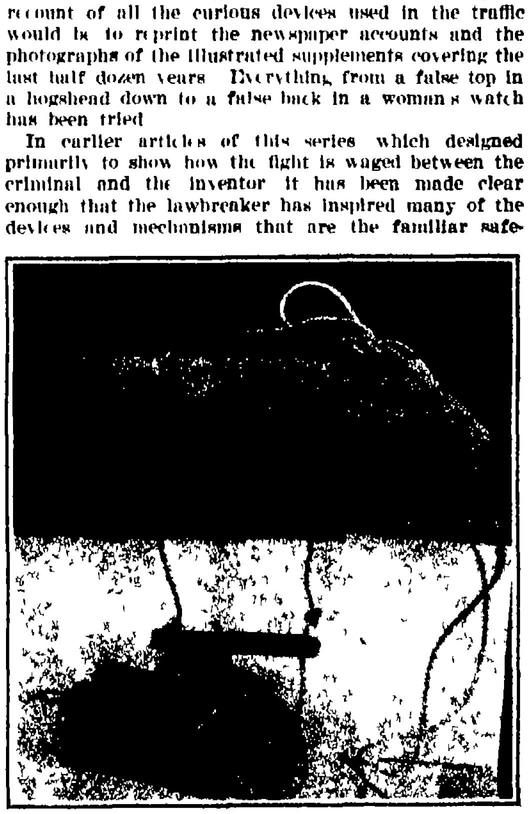
Then two Perso-Christian priests reached Constantinople and the attention of Justinian They had been proselyting in China and now carried back with them something that must have been regarded as more precious than converts—the secrets of silk culture Justinian was told what Aristotle had vaguely guessed at Immediately his imagination glowed He commanded the missionaries to return to China and bring him back some of the eggs of this wondrous worm

But how could that be done? the priests protested To take the silkworm or its egg out of China was an offense for which generals and princesses had paid toll to the headsman

Justinian pointed to the bamboo staffs his informants carried Were they not hollow? Could not the eggs of the *bombyx* be concealed therein? So the Christian missionaries went forth stole the eggs of the forbidden silkworm smuggled them across Western Asia as the emperor had suggested and so brought the rearing of the most valuable of fabrics to Europe

The story of the imperial master of Byzantium and Rome cannot pose either as a rare example of crowned criminality nor as the first case of inventive talent applied to crime, but it serves well enough to introduce the subject of the artfulness and inventiveness of the criminal in every time and age Smugglers have surely not been the least ingenious of men in this direction, and Justinian's improvisation of the bamboo egg carriers can hardly be rated high among the inventions of this crew When one considers how gems have been smuggled out of Golconda and South Africa by nude natives, how such bulky products as salt, tobacco and tea have been constantly dealt in where the governments held a monopoly or enforced a heavy impost, with what generality of success diamonds are brought into this country from abroad, the handling of a few insect eggs becomes insignificant One thinks of the false bottomed trunks the hollow heels and walking sticks, the concealed seams and pockets in women's clothing—all the thousand and one artifices that come to the attention of our customs men every year One must recall also the enormous business of liquor smuggling that is today one of the most remarkable political and social problems and consider the thousand artifices and special devices employed therein Drug smuggling is however, the most interesting and baffling field of this crime now in existence and to it most of the ingenuity of the modern smuggler is devoted To attempt a recount of all the curious devices used in the traffic would be to reprint the newspaper accounts and the photographs of the illustrated supplements covering the last half dozen years Everything from a false top in a hogshead down to a false back in a woman's watch has been tried

In earlier articles of this series which designed primarily to show how the fight is waged between the criminal and the inventor it has been made clear enough that the lawbreaker has inspired many of the devices and mechanisms that are the familiar safeguards of modern life Incidentally, many contraptions of the criminals themselves have been dealt with, such as the various mechanisms and cheats used by gamblers, the fire bombs of commercial incendiaries, the various tools and implements of the check forger, the methods of the instrument forger and his enemy, the handwriting expert the special equipment of automobile thieves and the like



Rope ladder invented by a "second story man," so made that it can be wrapped about the body and carried without detection

A great many of these have not been created by criminals at all but devised for legitimate use and then converted to misuse Many devices employed by gamblers were made up for the innocent performances of parlor magicians The tools of the forger and counterfeiter of paper currency are those of the engraver paper maker and accountant. Bank and safe burglars have adopted nitroglycerine and the acetylene torch from industry All this has been made clear There still remains however, a considerable body of mechanical and other creations, of which Justinian's hollow staff is an instance, and which belong to the crook himself

The largest field belongs to the burglar A complete statement of all his creations would involve a history of the art of breaking and entering surely one of the oldest among men One wonders immediately what tools the Egyptian grave robbers used who broke into the pyramids some five thousand years ago and into the rock hewn crypts in the Valley of the Tombs of the Kings eighteen hundred years later Probably nothing more formidable than bronze chisels and hammers and boundless patience, wherewith to work a way through enormous thicknesses of stone

Nor may curiosity quite pass by the tools used by classic housebreakers against those crude strange locks that closed the houses of Greece and Rome against the wandering thief Indeed, there is reward of information on this topic for the patient researcher in every civilization, however lost in time To every tribe there has come property and with it the thief To every hamlet, every half barbarous village, advancement has brought the permanent dwelling and with it the breaker in Thus locks were ushered into the world and by their token burglars' tools

The tools of the eighteenth and nineteenth century housebreaker seem most fascinating. There are reprinted herewith some photographs of these tools. It cannot be said that they differ greatly from the implements of other mechanics They do, however, belong distinctly to the inventions of the criminals themselves We see, for instance, a great assortment of skeleton keys, used to open the warded locks of the late nineteenth century and still effective against the simpler bolts of today The tools of coiners, also, look like ordinary implements, but criminals used them first and devised them in this form Most men are familiar with what the American underworld calls brass knucks and the British knuckle dusters. These, and their deadly relative, the skull dagger, are the inventions of

thugs and roughs, and have no honorable prototype

There is also the photograph of the tools used by the famous Charles Peace, an English burglar of the 1870's, whom many British writers upon criminal subjects seem to regard as a most remarkable and masterly housebreaker. The tools are interesting because they show the home-made implements of fifty years ago for contrast with the finished devices and mechanisms used by burglars today. Perhaps the popularity of Peace as a notability rests on some such ground or, more likely, upon the facts that he owned and loved to play Cremona violins, that he was a giant fellow, an irrepressible amorist and in due time a victim of the gallows for that he shot an interfering and contumacious husband.

The inventions of prowlers, as housebreakers are called in the argot, may not however be limited to such men and times. Before Peace's day an American breaker had invented the dark lantern or bullseye from which all the modern electric flashlights have been adapted. Wooden wedges, with which to attack the mortar in brick or stone walls without causing the ringing sound of a steel chisel; hammers capped with thick pads of rubber to further deaden the sound of blows; the jimmy and its child, the collapsible jimmy; the fine steel wedges used in working a crack into the jamb of a bank safe to admit of the infiltration of nitroglycerine; the finespun ropes of silk by which burglars let themselves down from the roofs of the tall loft and apartment buildings in New York to gain entrance through a window two hundred feet from the ground and a hundred or more from the roof; all these and many more belong to the burglar's inventive domain.

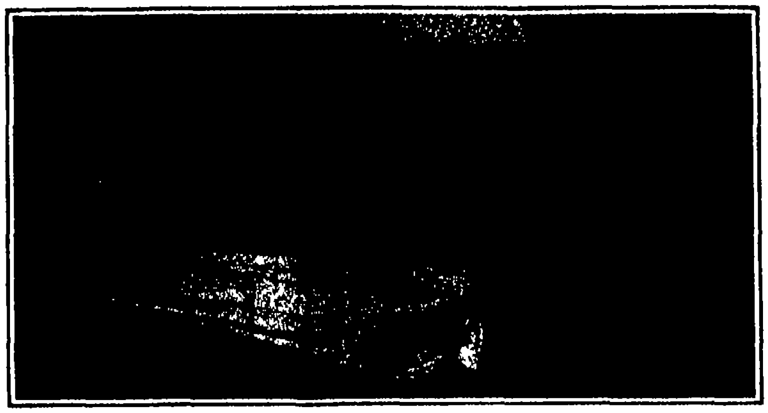
Far more romantic, however, than these instruments used for breaking in are the inventions employed for breaking out. The strange contrivances which imprisoned men have bent to the great purpose of freedom must form a thick chapter in any volume presuming to contain even the first color of the romance of escape. We need not concern ourselves here with the file that Casanova had smuggled to him in a great pie, with the familiar saws and cut bars, with the ladders of torn bedding by which men have scaled walls against freedom. No vitality shines from such commonplaces.

But where these familiar things leave off the strangeness begins. Incarcerated men have picked up bits of wire in the yards, shops or stables of prisons and fashioned from them picklocks by which scores have been liberated. A bit of rusty tin has been taken and by prodigies of labor and patience wrought into a tool to set at naught all the precautions of warders and prison architects. In 1846 Louis Napoleon, a prisoner in the fortress of Ham for his opera bouffé invasion of France a few years earlier, let his aides, who were permitted to live in prison with him, get the prince up in the clothes of a workman. So attired he took a long wide plank on his shoulder, stuck his riding boots into big sabots and marched out of prison without a word, the turnkeys accepting him as a carpenter without question. Six years later the same escaped convict was emperor of the French.

This exploit was emulated a good many years later at Dannemora by no less an offender than the celebrated Soap-box Hardy, who quickly slipped on the uniform of a painter, which had been left hanging in the clothes room. Picking up a brush and pot, he too walked blithely out into the sunshine and golden air of freedom.

A few years ago in one of our western State penitentiaries a convict escaped by the old manner of cutting through his bars. He was at liberty only a few weeks or months when the police picked him up and returned him to his shadowed house. The prison officials, as is common in such cases, demanded to know where the man had got his saw. He shook his head with dejected doggedness and said he'd used none. Guffaws among the warders. Still the man blinked, held himself in a kind of stupor and insisted that he had not used a saw, that no one had smuggled such an instrument to him and that he had been without accomplices. The keepers menaced him and applied their tongue starters. Their victim bore the pain as best a man can in silence. They tossed him into the dungeon, where he lay groaning but spoke no word.

Eventually, the many won another of those struggles which the ego seems destined to lose. The escaper gave sign that he was willing to talk. They dragged him from his hole and he shuffled away to the machine shop, where he looked about and finally picked up a bit of twine. This he dipped into the gluepot at the far end of the building, where the carpentry was done. He carried it dripping back to a steel table where some emery was lying about and twisted his sticky string in the powder. As it dried the bits of emery held fast and he had a moderately effective contrivance for an immoderately patient and determined man. He said it had taken him three months to cut through the bars in this fashion. The officials believed him and so set down the case upon their books.



Outside, an innocent roll of cloth. Inside—the smuggler's delight!

They put this remarkable escaper into another cell and took precautions against the abstraction of twine and glue and emery powder. Nevertheless at the end of about three and a half years the same man again made his escape and his bars showed that they had been cut through in exactly the same manner as before.

The prison intelligences began to waken at this. The man had not had access to glue or emery or twine this time. As a matter of fact he had before the previous escape been employed in a quarter of the prison which must have made it impossible for him to visit the shops and get string after string of glued emery. The convict had hoaxed them.

This time they did not get the bar cutter back, but his story is well known among the underworld elite. The man had used nothing but woolen strings carefully drawn from the rough stockings furnished by the State. These he had moistened in his own spittle and then rolled in the dust of his floor, sticking them against the stones of his cell wall till they had partly dried. With these frail strands he had attacked the inch thick steel bars.

The typical kit of tools of the up-to-date burglar. While in a way modelled after ordinary tools, they are of decidedly specialized form

At night when he had been locked in his cell and the lights-out signal given, this giant of patience had crept from his couch and begun pulling his sandy string back and forth across a bar. It took many nights before he made an impression, taking a few swipes at the bar, then listening intently for the rubber shod footfall of the roundsman, then swiping again at the cage, till the night was half spent. He got little sleep. They worked him hard in the brickyard. He lost weight and grew ill. Still he did not give up. He suspended his work for a time till strength returned. At last he had one of the two necessary bars cut almost through, so that a quick wrench would jerk it from its place. He smeared the cut with earth and lime and touches of green paint and red brick dust. And so he attacked the second.

The prison officials did not suspect him. They made cursory examinations of his cell but did not sound the bars. Besides, this man was an emery user and he had none!

Slowly again then, like the drop of water on the slab of granite, like frost and thaw at the heart of a crag, like time itself against the mountains of the world, this insuperable man went on to cut the single bar that stood against his freedom—a thing most likely empty, a mere word. It took him almost all of three and one-half years to do this deed of forfeit valor and sublime tenacity. Once ready he rested and ate his fill again so that his strength might not fail him once his foot was on open ground. Then one night when the moon was beyond the world rim and clouds had soiled the faces of the Pleiades he was gone.

At the Federal prison at Leavenworth in 1901 the invention of a convict made possible the historic mutiny and jail break in which twenty seven determined men got away after killing and wounding their keepers.

The new prison, as it was then called, was being built by convict labor on a hill site west of the town. The convicts were kept in the old prison, later called the military prison, in the fort two or three miles away. Every morning a file of four or five hundred convicts was marched out of the old prison and along the roads and stream beds to the new side. Here they worked inside a wooden stockade, laying bricks, erecting walls, building the very cells that were to contain them in the future.

One sunny afternoon three or four of the leaders among the convicts walked over to a point of the stockade, stuck their shovels into the earth, turned over a little sod and procured several heavy revolvers and extra ammunition, which had certainly been planted there by accessories from the outside. So armed they advanced on the main gate, which had a tower above it occupied by a guard with a repeating rifle. Inside guards rushed to head the mutineers off and were shot down or driven to cover. In an exchange of shots between the convicts and the tower guard one convict and the guard were killed. The gates were thrown open and the convicts ran out, followed by others to the total of twenty seven.

The puzzle of the thing was solved when one of the ringleaders fell into the hands of the prison authorities and confessed. This man had been in communication with an outside agent by means of secret writing. The prison people were more puzzled than ever. What means of secret writing had men within the prison walls? How could they get the necessary tools and chemicals? What code had they that had passed the eye of the prison censor?

The captive leader drew a piece of calendered paper toward him and asked for ink and a pen with two clean points. With ink on the first point he scrawled out a conventional and innocent letter of the very kind a convict would write home. The officials did not even note that the lines were spread rather far apart.

After this writing had been permitted to dry thoroughly the demonstrator put the clean pen point into the holder and moistened it with his tongue. Thus, with spittle he wrote between the lines of the original letter this menacing sentence:

Leave four gats and extra shots buried inside and under thirty fifth paling of stockade west of main gate by October 5.

There were no magician pen top readers present and none knew what had been set down.

The captive allowed the sheet to dry completely. Then he passed it among the officials asking if any could see any marks or make out any letter. All were baffled. Laughing shortly the convict dipped a small sponge into the inkwell and rapidly spread the blue ink

(Continued on page 426)

Taking the Stenches Out of Industry

The Embarrassments of Left-Handed Perfumery, and How They Are Often Eliminated

By James H Collins

ONE little item in Bingville's daily housekeeping—three thousand tons of garbage more or less

Day after day the city hauls it away and dumps it Soup bones and potato peelings melon rinds and apple cores the burnt hash from the boarding house and the poor little bride's first biscuits, mixed with such and such a percentage of tin cans empty bottles, broken glass and china and lost silver—it doesn't look much like wealth! But there are dollars in it—4 per cent of recoverable grease worth easily three million dollars yearly and 11 per cent of tankage for fertilizer, worth a million or two more Call it a round five million, or a good home built *every day for* some taxpayer

Some years before the Great War began a corporation made a contract with Bingville to take this garbage and render out the grease and fertilizer by an odorless process keeping those by products for its trouble and relieving the city of expensive hauling and dumping Construction work was begun on a large plant, but before it could be put into operation the war upset things Steel trebled in price, coal rose from $3 to $8 a ton, wages *for common labor from* $1 75 to $4 50 a day So the rendering plant cost more than its promoters had estimated That didn't trouble them when they first got going, because grease and tankage were also selling at better prices But it was soon found that operating costs were higher too And then when we got into the war, those food conservation signs "Save the Fat!" cut the amount of grease in Bingville's garbage to such an extent that, where there had been eighty pounds to the ton in normal times thirty pounds was about all that could be hoped for

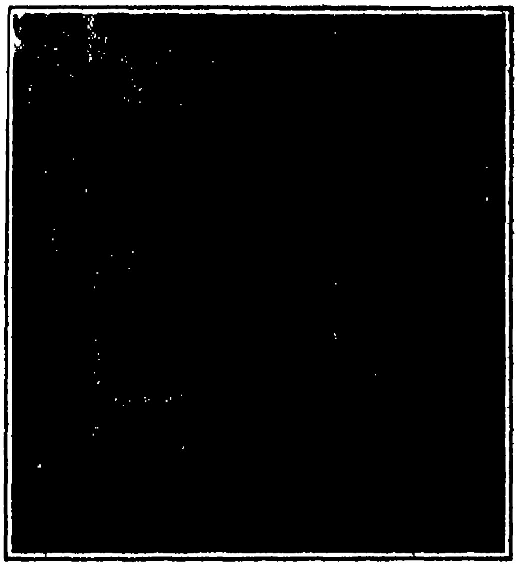
That rendering plant had to shut down, and today stands idle while Bingville has gone back to dumping its garbage Unbalanced business conditions during the war were to blame for this failure, but it was actually a bad smell that caused the shutdown They built their plant believing that, with modern engineering practice garbage could be unloaded and treated without offensive odors. But several hundred thousand dollars were spent unsuccessfully in efforts to make the process inoffensive

Chemists and engineers worked on the problem and the solution often seemed to be just around the corner Inventors turned up by the score announcing that they had solved it and offering to install an apparatus that would make the place as sweet as a cow's breath—not altogether the free-lance inventor with a wild look in his eye either but bachelors and doctors of science in the employ of responsible corporations Generally, *they wanted about five thousand dollars to install their* apparatus seldom any more and in many cases only two or three thousand But when the garbage company made a counter proposal, offering to pay twenty five thousand if the apparatus eliminated odors after the inventor had installed it at his own expense—it had no takers!

By the rendering process used in this plant the garbage was brought in as quickly as possible to have it fresh and least odorous After cooking to extract the grease the residue left was dried down into "tankage" valuable to the farmer for its nitrogen and humus. Practically all the odors went up a very high chimney in the form of heated gas except the odors of cooking which were kept pretty well inside the plant In these gases, something like thirty to fifty tons of fine dust went up the chimney every day This dust had a bad odor Believing that it carried all the odors, engineers installed apparatus to wash it out of the gases with sprays of water In this way practically all the dust was extracted It *had* a vile odor and though rich in fertilizer values for the farmer, was so difficult to dry that the company let it run into the sewer

But the gas going up the stack still smelled!

Then they tackled the moisture in those chimney gases. You have probably noticed that the fragrance of flowers in the country, and new mown hay and freshly turned earth is *sweetest early in the morn*ing when the grass is heavy with dew Water vapor in the air carries this fragrance—and tons of water vapor going up the stack carried some of the fragrance of garbage, in quite the same way



Activated-carbon absorber used in removing odors from the air

So apparatus was installed to condense this moisture by blowing the chimney *gases through water sprays* and all but a very small percentage of uncondensable gases were eliminated from the chimney

But the small volume of those uncondensable gases had positively the worst odor of all! In the laboratory, they could be made odorless by very high degrees of heat but it was never found possible to apply this principle commercially, as the cost of extra coal would have been prohibitive

Despite these efforts, the plant had a bad reputation among people who lived *around it* Certainly *a large* proportion of offensive material in its chimney gases were kept out of the atmosphere, so it was not actually as bad as a garbage plant run without such deodorizing devices. But people complained of bad smells, nevertheless and in the end the health authorities closed it as a nuisance

The final chapter was interesting

The health authorities insisted that the plant gave off bad odors and the management while admitting that some odors escaped, maintained that they were not in sufficient volume to be offensive The chimney was high, and shot its gases out at such an altitude that odors did not reach people living nearby, but were generally reported at such distances that the garbage works had a pretty good alibi However when the health authorities sent up an airplane with two men who cruised down the wind until they smelled garbage followed it straight upwind and came to the garbage company's chimney—the jig was up!

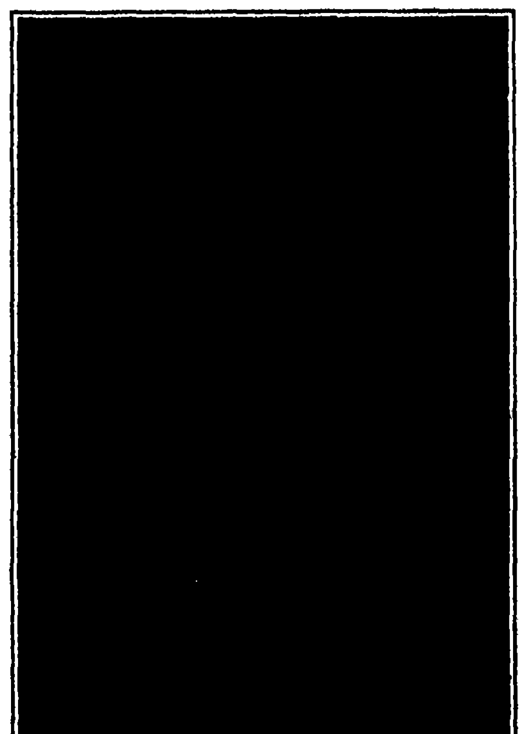
Millions of dollars have been lost in the search for a denatured garbage-rendering process and some of the engineers who have gone furthest into this proposition declared that the wealth in garbage is like the gold at the rainbow's end

"I have solved the puzzle over and over!" says C R Van Etten, an engineer well known as a specialist in this field "Once I knew all about it, but now there is only one thing I feel sure of—that incineration is the best thing for garbage Burn it up! Reduce it to the irreducible!

That is, incineration by methods such as they have developed over in England. An incinerator of the latest British design might be operated alongside a cathedral, so far as offensive odors coming from garbage after it enters the plant is concerned Garbage is generally self burning, for besides table scraps containing fat, it is mixed with paper, wood, leather, cloth and other combustible rubbish These incinerators burn *it at very high temperatures, 1400 to 2000 Fahrenheit*, destroying practically everything. Instead of one furnace, a series is used, all having a common combustion chamber for mutual assistance One furnace contains a fresh load of garbage, just started and giving off flue gas at a moderate temperature which would be odorous if it reached the atmosphere An adjoining furnace, however, is in full blast, giving off high temperature gases and a third will be a mass of cinders emitting even hotter gases These gases are mixed together in the common combustion chamber, so that all odors are burned up and destroyed by the high temperatures before *the gases escape from the chimney* Moreover these gases are used to heat the forced draft that is drawn back through blowers to feed the furnaces Incineration does away with much of the expense of hauling and dumping garbage It can be collected and burned at small incinerators scattered over the city Indeed incineration has now begun in our cities, for practically every large apartment, hotel and institution built nowadays has an incinerator installed as part of its equipment

"On the surface the wealth in garbage seems like easy money But try to get it out at a profit, and you will find that it is the squeal *of a pig not worth saving*"

But right in those war times that were heaping trouble on the Bingville garbage works, there stood at every other city street corner a barrel which, had the garbage men only known it, held something new and promising *in the way of odorless reduction* You remember those barrels—common flour and sugar barrels, beautified with white paper and a Red Cross sign into which people threw cocoanut shells, peach stones and other fruit pits to make a peculiar kind of charcoal that the Army wanted for gas masks



Activated-carbon absorber by means of which gasoline is recovered from natural gas

Out of those barrels the chemist eventually evolved "activated carbon," a substance that promises to free industry of all offensive odors, bringing the packing house glue works soap factory fertilizer plant and like establishments, now often banished to the waste places, right into town where they will be handy to raw materials transportation facilities and customers. Better yet, it may squeeze money out of a noisome industrial smell yielding by products to pay for the trouble

The chemist and inventor now seem to be closing in on the offensive odors of industry from several directions, after many failures They have tried to wash out bad smells, to burn them out, to concentrate them, to shoot them so high up tall chimneys into the welkin that they would vanish—even to make people like an objectionable stench by perfuming it with some volatile, pleasant-smelling chemical.

Some of these methods were successful in making the factory itself odorless When the visitor goes through a certain big eastern soup-canning establishment, for instance, his attention is called to the fact that there is practically no odor of cooking The

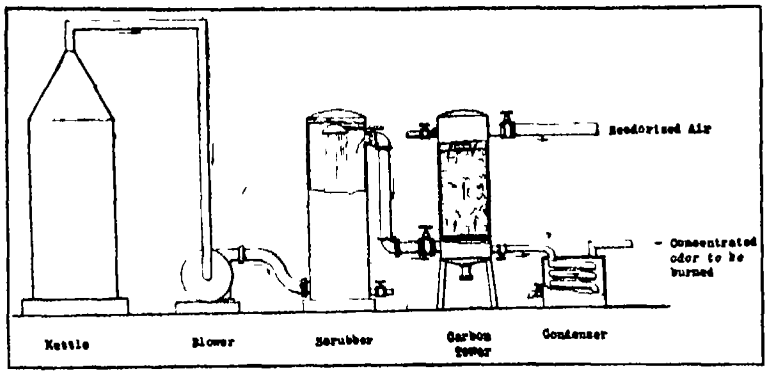
bouquet of good warm nourishing soup is pleasant of course, but they keep it out of that factory with large rotary blowers If you want to smell the soup it is necessary to go several blocks away *from the factory*

However, even the most offensive industrial odor doesn't bother people working in the factory that creates it. They become accustomed to it in a few days and smell nothing It is the same with pleasant odors —the young lady with a job in a perfume laboratory is fragrant as the rose, the lilac and new mown hay People know when she is coming a block off, but she herself smells nothing And offensive industrial odors are seldom harmful unless they contain actual poisons, like acid and ammonia fumes Bad smells may nauseate people unaccustomed to them, but workers in the odoriferous industries are generally pretty healthy

It now seems quite likely that, within a few years when people complain of an offensive factory its odor can be scientifically eliminated by one of several methods lately discovered They have been carried through the laboratory and experimental stages, but not yet widely applied on a commercial scale because there is still considerable research work to be done on the particular perfumes of the different industries

The smelter fume nuisance has been largely done away with by Dr Frederick G Cottrell's *famous precipitation apparatus Before this invention* crops and vegetation for miles around a copper smelter were often killed by the fumes from its stack causing constant complaints and disputes Farmers maintained that the fumes were "pizen," while smelter men insisted that neighboring agriculturists were really "smoke farming"—that is, planting crops near a smelter not with any idea of marketing them in the regular way but to collect damages from the smelting company if they didn't thrive The Cottrell process doesn't really affect smelter fumes, but simply precipitates metal and dust particles from them with electric currents of very high frequency Besides saving valuable metal dust, it allows the gas, *fumes and smoke to pass up the stack hot, where before* the dust was washed out This cooled the gases so that they sank down on the surrounding neighborhood and made trouble whereas hot gases rise and are diluted with air, doing no harm The apparatus is also used in cement kilns to prevent damage to surrounding vegetation by cement dust. Dr Cottrell's invention has also been *of great public service because all* the royalties that it yields go to finance scientific research, his gift to the public

The idea of soaking up a bad smell with "activated carbon," as you mop up dirty water with a sponge, grew out of the war-time chemical investigations of Dr N K. Chaney which made our gas mask far better than any used by either the Allies or the Germans Your fruit pits and nut shells were turned into charcoal Charcoal is carbon, and according to the stuff it is made of —peach stones, cocoanut shell, wood or coal of various kinds—and *also the way in which it is made* has more or less affinity for odors. Odors good and bad are carried by complex molecules taken up by charcoal, while the simple molecules composing air water and some of the gases pass through unaffected Some charcoals like those made out of the leavings in the Red Cross barrels, are very active—sponges with such an insatiable thirst for complex odor molecules that they will take up more than 50 per cent of their weight of certain vapors or one volume of charcoal will absorb fifty to one hundred volumes of odorous gas depending upon its character Other kinds of charcoal however have little affinity for odors "Activated carbon is a kind specially made to sop up and hang onto odors as they pass through a mass of it



The general lay out of an installation using activated carbon for the elimination of stenches

Suppose you have a factory so offensive that people are up in arms about it Dr Chaney and Dr A B Ray have told, in one of their technical papers, the story of such a factory in an eastern State It was a tiny place, employing only half a dozen men but—Oh my! The owner honestly tried to wash and burn the odor out of his activities but with no success and finally was notified by the health authorities that he must either shut down or move away *During his* gas-mask researches Dr Chaney had an all around experience with offensive odors fumes and gases and learned that with a charcoal gas mask one could work in the foulest and densest odors and be wholly unaware of them This little factory was investigated all apparatus from which bad smells arose made airtight the offensive gases drawn away in pipes and passed through activated carbon The apparatus was built hurriedly, in an emergency but worked so well that though it was installed more than a year ago the factory has since run steadily without a single complaint *It took two tons of cocoanut* shells to make half a ton of cocoanut shell charcoal for the carbon tower that acts as an odor sponge The carbon is worth up to 75 cents a pound and there was a moderate investment in kettle covers piping and blower equipment The system is virtually automatic The actual weight *of an offensive smell is very small*, so a carbon sponge of this type will operate a week before it needs squeezing out Then the night firemen turns live steam through the system distilling all the offensive material in concentrated form into the fire-box of the boiler where the heat destroys the smells When the carbon has been revivified in this way it is again a clean thirsty sponge ready for work Such deodorizing charcoal has been used three years in some cases without deterioration—rather it seems to improve with use and one shortcoming of activated carbon as merchandise is *that* customers buy it so infrequently and for some purposes only once

It may be that there is something worth saving in the odor from your factory Or gases not offensive at all are dissipating good material as they pass out into the atmosphere The waste gas created in fermenting corn for example contains acetone butanol and ethanol, which can be caught by the carbon sponge and recovered by distillation Gasoline alcohol benzol ether and other volatile liquids used as solvents in many industries and largely lost through evaporation are now recovered by treating them as though they were offensive smells Gasoline is also extracted from natural gas, thus far one of the principal industrial uses of activated carbon and light oils as well as sulfur extracted from illuminating gas before it is sent through the mains to the consumer

The principle is sound but still so new that the practice for different industries must still be worked out by engineers.

Take the case of a garbage reduction plant as an illustration where there are several hundred million cubic feet of chimney gases daily to be deodorized Before the engineer can design an apparatus for such purposes, the chemist must measure what he calls the stench load of garbage gases In extracting gasoline from natural gas he has figured its weight per cubic foot of gas the pounds of gas

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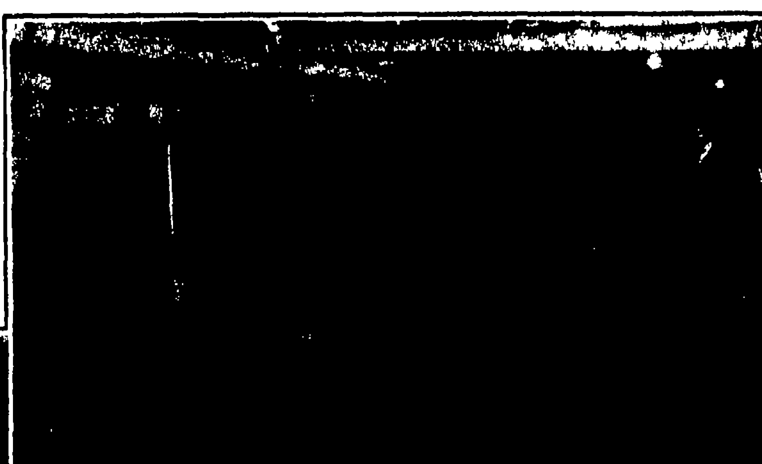
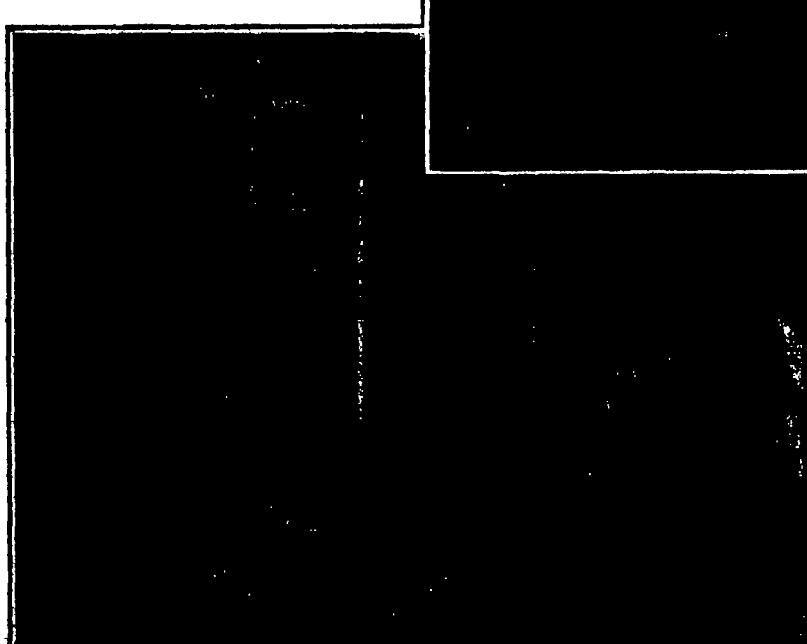
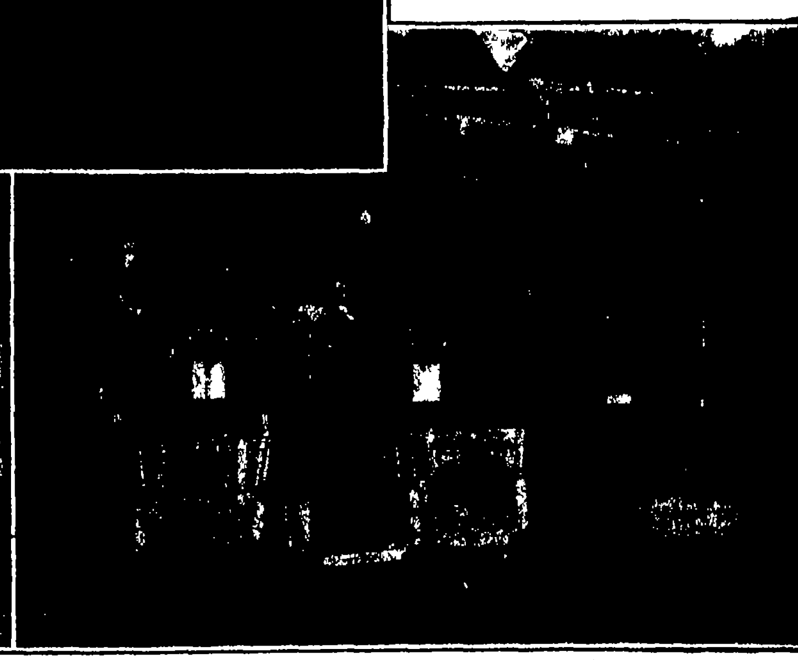






Above: Pressing tallow from cooked product. *Below left* Melting raw beef fats. *Below right* Cracklings coming out of the press, ready for market

Taking the odor out of the packing industry by aid of a new process of dry rendering

Our Point of View

Charles Allen Munn

IT IS our mournful task to record the death of Mr Charles Allen Munn, the late President of the Scientific American Publishing Company, in the 65th year of his age His death occurred when our May issue was on the press, and in order to avoid the delay of one month in the announcement, we decided to publish an insert memorial which our subscribers received with the May number, but which was not available for our newsstand copies

The subject of this memorial came of old American stock, the first ancestor of the family to settle in America being Benjamin Munn who served in the Pequot War From him descended Reuben Munn who raised a company and marched to Cambridge at the time of the Lexington alarm call, and who subsequently served under General Gates and was present at the surrender of General Burgoyne at Saratoga The deceased was the second son of Orson Desaix Munn who in conjunction with Alfred Ely Beach purchased in 1846, a publication known as the SCIENTIFIC AMERICAN, which had been started in the previous year It may truly be said that the history of the SCIENTIFIC AMERICAN during the seventy eight years of its existence is the history of the life work of the father and son, for Mr Charles Allen Munn after preparation in Paris and in Princeton University, where he graduated in 1881, entered the office of Munn & Company in that year, and thereafter until the time of his death for a period of forty three years, devoted himself closely to the interests of the SCIENTIFIC AMERICAN and its affiliated publications and enterprises

Mr Munn was at all times an enthusiastic sportsman, but, outside his business interests, the subject which lay nearest his heart was his collection of *Americana* and especially his *Washingtonia* which grew to be the most notable in the country He was one of the leading authorities on *Americana*, and his town house at 62 East 65th Street, New York City, contained several of the best known portraits of Washington by Gilbert Stuart, Trumbull and Peale, the last named being a full length portrait. The collection includes Wedgwood portrait cameos mezzotints, miniatures, diaries, letters, etc, of Washington and others of the founders of the republic Students and lovers of *Americana* will rejoice that this fine collection was willed by Mr Munn to the Metropolitan Museum of Art of New York City

Possessing an attractive personality Mr Munn gathered about him a large circle of friends among whom his loss is greatly deplored Underneath his brisk business exterior, lay a very sympathetic heart and it was rarely that any supplicants for financial aid who found their way to Mr Munn's desk were turned away His name was also to be found on a long list of philanthropic church social betterment and kindred societies.

The deceased was a member of the New York Bar and one of the charter members of the New York Patent Law Association He was one of the founders of the Essex County Country Club, and captain of its polo team, and was a member also of the University, Century Groller, Merchants Racquet and Tennis, Union and Knickerbocker Clubs. He is succeeded as President by Mr Orson D Munn, grandson of the founder of the SCIENTIFIC AMERICAN, who will thus represent the third generation in the ownership of this publication

Airplane-Battleship Controversy

IN OUR issue of December, 1923, we published an article credited to the staff and entitled 'Driving the Bomber to High Altitudes," which gave some startling information as to the great advance which has recently been made in the range and accuracy of antiaircraft artillery The facts were furnished by a high ranking officer of the Coast Artillery Corps, and were therefore fully authentic

In our issue of April 1924 we published an article "Bombing the Battleship ' which was written by a member of our air service, who requested that his name be not used as the author—a not infrequent request which is always scrupulously respected. Unfortunately, the editor who made out the list of contents for that issue was under the impression that it was a staff article and so named it. The nameless writer is evidently a strong partisan of the airplane side of the airplane-battleship controversy, but since we had already published Admiral Gleaves' article "Has Sea Power Passed?" in November, 1923, and the aircraft article in December of that year, both favorable to the defense against bombing, we decided to let this bombing enthusiast have his say and say it in his own hyperbolean way

The immediate result of the publication of this last article has been the receipt of a letter of protest from Major General Coe, Chief of Coast Artillery, and other artillery officers, who complain that the spirit, if not the facts, of the April article are at variance with those of the December article The point is well made, and we repeat that the April article was not written by the staff but by a contributor

The position taken by the SCIENTIFIC AMERICAN on this question of the supremacy of aircraft over ships of the sea has never varied From the very first we have deprecated the extravagant claims of the air enthusiasts, and particularly of Sir (now Admiral) Percy Scott The battleship never was, is not now, and for many years to come will not be in danger of being "swept from the seas" Scott's (or was it Fisher's?) 'sack or scrap the lot is picturesque and that is all

And in our saying this please do not suppose that we undervalue the great advance which has been made in naval and military aeronautics For coast defense, for scouting, for spotting (after the enemies planes have been shot down), and *under exceptionally favorable conditions* for torpedo-plane and bombing attack, the airplane has an undoubted value—limited today capable of great development in the future But until that development has proceeded to the point where the whole game can be lifted from the sea into the air, let us hold on to the well proved system which we have

The Great Flood at Panama

SOME twenty years ago when engineers were deciding whether to build a sea level or lock canal at Panama, the controlling physical factor was the enormous floods which often descend upon the canal from the Chagres River during the rainy season The opponents of a sea level canal predicted that the enormous rush of water coming down the Chagres would produce currents in the canal which would render it unnavigable and threaten its very existence

The advocates of the lock canal claimed that the only way to handle these floods was to build a huge dam at Gatun near the mouth of the river and form a lake over 160 miles in area which would catch and hold these flood waters and prevent their destructive effects. That the sea level canal advocates were correct, was proved last October when the Isthmus was subjected to an unprecedented rainfall lasting a week, and there was a flood discharge into the canal that broke all previous records.

The dramatic details of this flood are described by Governor J J Morrow of the Canal Zone in an article in the *Military Engineer*, from which we learn that the probable inflow to Gatun Lake at the maximum period of the flood was between 250,000 and 300,000 cubic feet per second, and that for twenty-four hours on the 24th of October the Chagres discharged into the lake over 15 000 000,000 cubic feet of water

Now Gatun had not only to receive this huge flood, but continually to get rid of it. It was for this purpose that the spillway at the center of the Gatun dam was provided with fourteen gates with a maximum discharge capacity of 200,000 cubic feet per second Previous to this flood, the opening of seven gates had been sufficient, but as the downpour continued, two more gates had been opened, and then two more, making eleven in all, and under these conditions a flood of 155,480 cubic feet per second was passing through this spillway During the whole period, of the flood from October 22d to October 27th, inclusive, 42.4 million cubic feet of water were wasted over the spillway This is equal to ten feet depth of water over the whole 166 square miles of the lake

Except for some slides and wash-outs on the Panama Railroad, and a large slide into the Canal which did not seriously interrupt traffic, the canal, thanks to the watchfulness and energetic action of all the canal employes, passed through this ordeal practically intact

A Machine That Makes Its Own Repairs

THE other day we heard a man grumbling about the doctors He roundly asserted that, as diagnosticians, they were but a sorry lot "Something goes wrong,' he said, "with a complicated machine in my factory or a delicate instrument in my laboratory I call in a professional engineer or a skilled mechanic He very quickly locates the trouble (that is to say, diagnoses the case), readjustments or repairs are made and the worry is over Now the body is a machine and the doctor is the professional engineer He has spent a lifetime in the study of this machine, and he has at his disposal all the accumulated experience of his profession for ages past. Something goes wrong with this machine You call in the doctor, he diagnoses, prescribes medicine, diet, etc You follow instructions faithfully, but with no results. You try another doctor—same result. You go to a specialist, to two or three of them, and you are lucky if you don't collect as many different diagnoses and end up on the operating table No take it from me, the average doctor, as the professional engineer of this machine we call the human body, simply isn't in it with the mechanical engineer in finding what is wrong with a machine and setting it right '

Then we pointed out to our friend that to compare the most ingenious and perfect mechanism ever made by man with the human body, was as foolish as to place his baby's go-cart in the same class with a Rolls-Royce motor We asked him to consider that although the modern high-class automobile in respect of the ingenuity of its design, its power, durability, speed and ease of control, may be regarded as the most perfect mechanical triumph of the age, it is but a child's toy in comparison with that crowning triumph of all creation, man. Not only is this body of ours a heat engine, with an efficiency undreamed of in any heat engines of man's construction, but it is a self-contained chemical laboratory, in which are carried on, ceaselessly and surely, scores of differing elaborate reactions for the production of the substances needed for the growth and repair of the body

For one point in which the man made machine may go wrong there are a thousand where this infinitely complex human machine may slip into trouble We bade him be fair to the doctor by recognizing the infinite complexity of the problem of making the right diagnosis in a complicated human disease

And then, to drive in the last nail of conviction, we dwelt upon the marvelous fact, that the human machine is self-repairing To match that, the automobile would have to be capable of building up the walls of its cylinders, the surfaces of its piston rings and the seating of its valves, continuously, and in the exact measure in which they were worn away And as for the tires, they would have to fabricate new rubber on their treads as these were ceaselessly disintegrated; and when a deep gash was cut in the shoe, molecule by molecule new rubber would have to be built up by the tire itself, automatically, until the wound was wholly closed.

Although it is true that but for this marvelous power of self-repair, the doctors and surgeons would, indeed, be in a hopeless quandary, we may at least be assured of this that the most difficult repair job in a garage or a factory is simplicity itself compared with repair work in a hospital of sick men.

Here and There

AMONG the most weighty of the Federal Government's activities, and far from the least interesting thereof, are those of the Public Health Service. Few of us realize the extent and the wide variety of the work undertaken by this bureau. Many of us even are quite without any adequate concept of the wide field over which the public health engineer today must spread his labors. With no pretense of covering this field but merely to indicate some of its more interesting angles, "Here and There" this month is given largely to a display of several interesting personalities and several interesting undertakings of the Public Health Service.

SOME of us live to eat, and others eat to live. Individuals of whom the former may be said are fairly well confined to the human race, but of those organisms who make the absorption of nourishment a mere prerequisite to living rather than the chief aim and ambition of life, we humans are a distinguished minority. The dark gentleman of the adjoining picture serves meals every day to a population vastly exceeding the sum total of the world's human inhabitants. He is "chef" to the colonies of bacteria maintained in the laboratories of the Public Health Service. L. J. Bender is his name, and every day he prepares some 6000 tubes of soup-like material of one sort or another for his minute charges. The finest steak, eggs, potatoes, gelatine, milk and other edibles coming within our own understanding of the term are employed together with numerous chemicals necessary for the life of the germs that eat them, and falling rather outside our own dietary field. The statement that Mr. Bender feeds a clientele far surpassing the human total follows from simple multiplication. The tubes of which he puts up so many during the course of his day are designed to feed, on the average, ten billion bacteria each. We don't want to put an undue drain upon the compositor's supply of zeros, so we leave it to the reader to find for himself how many residents of Uncle Sam's bug hotel are fed from Mr. Bender's unique kitchen.

L. J. Bender

ANOTHER interesting job in the Public Health Service is that of Dr. E. T. Wherry, whose portrait adjoins in the corner of the page. To Dr. Wherry falls the task of attempting the purification and, presumably, the ultimate isolation of the important vitamins, and obviously he is called upon in the ordinary course of this work to make a great many identifications of chemical substances which he finds in and isolates from the materials upon which he is working. Ordinarily, chemical analysis or chemical identification without some pretty definite lead that suggests what to look for is a pretty long-winded task. Give the chemist a white powder and ask him what it is and if you withhold all information which might serve as the basis of a shrewd guess that would indicate what he may most hopefully try first, it is largely a question of good luck whether his answer will be reached in an hour or a week. But this is too slow for Dr. Wherry's work, an answer must be forthcoming more quickly. So optical methods are resorted to, and instead of analysis through test tube and retort, he uses the spectroscope and the microscope. He is shown here, working with a petrographic microscope. This instrument was designed in the first place for use in optical analysis of rocks, but by working with immersion oils of various types, it makes it possible for Dr. Wherry to get a very rapid qualitative analysis of other substances, the optical properties of the specimens varying in such a way as they are passed from one oil to an other as to give their composition away very rapidly.

Dr. E. T. Wherry

NO particular danger attaches to the work of Mr. Bender and Dr. Wherry. But the label "Public Health" must remind us of medical martyrs who have given their lives in the investigation of deadly diseases and since all the deadly diseases are not fully investigated it follows that there must still be done some of this sort of thing. The most perilous work being carried out by the Service right now is rather unsensational, compared with the attacks of past years upon yellow fever, malaria, and other spectacular plagues. This time it is nothing more theatrical than the effort to control a poisonous wood tick which infests certain regions of Montana, making these largely uninhabitable by virtue of the fact that its bite is usually fatal to humans. *Dermacentor andersoni* is the name of the little pest, and L. R. Spencer is the name of the doctor, portrayed herewith, who is conducting the assault upon him. By way of vivid proof that the work is dangerous we are informed that two members of the Public Health Service and one of the Rockefeller Institute have already met their death at the hands of the vicious dermacentor. Dr. Spencer's particular undertaking is the search for a serum that will confer immunity against the tick's bite. Experiments are progressing with rabbits and guinea pigs, and Dr. Spencer is about to transfer the scene of his experiments to the infested region of Montana, bearding the lion in his den, as it were.

Dr. L. R. Spencer

SQUINTING through the microscope at some strange or familiar carrier of infection is by no means the extent of the Service's contact with bugs and bacteria. They have a regular staff artist, whose whole job consists in making large size drawings and paintings of germs that are invisible to the public eye, and other creatures of similar sort. One of his recent productions was a large painting in natural color of the common stable fly, who is eligible for this treatment at the hands of a germ artist because he is alleged to be the carrier of the infantile paralysis infection. Professor Wilder—pardon our neglect to introduce him, L. H. Wilder is the name and at the top of the third column you will find the portrait—had to use up no less than fifty flies in making this particular bug picture because they are so fragile that they cannot be protected against accidental damage. Professor Wilder's masterpieces are employed alike in serious study, and for purposes of propaganda and public education. His work is a phase of Governmental activity pretty far removed from our grandfather's concept of public business.

SEVERAL years ago there was developed in England a process for dyeing in two colors, in patterns with a single dipping. This apparent contradiction is resolved into common sense when it is explained that the fabrics for such treatment were woven in silk and cotton materials combined, dyes being used which would "take" on cotton but not on silk, and vice versa. The goods being dipped in a mixture of two such dyes one would color the cotton and one the silk and the desired effect was produced. But the applicability of the system was greatly circumscribed by the scarcity of dyes which would affect the one substance completely, and leave the other absolutely untouched, and which at the same time should be commercially fast. Subsequent research however has been conducted in cooperation between cotton and silk makers each seeking dyes that would apply to his own product and leave the other uncolored, and a wide variety of these is now available—no less seven hundred odd. It is therefore now possible to use the double-dyeing process for a very wide range of effects, instead of being limited to about six simple colors as has heretofore been the case, and the process is regarded as of prime importance to the weaving and hosiery industries of Britain. The statement, with its suggestion of rainbow hose dyed at a single dipping and therefore within the reach of the modest purse, is sufficiently alarming!

Prof. L. H. Wilder

DRYOPITHECUS, or forest ape, is the name of the latest aspirant for rank in the genealogical list to which Mr. Bryan offers such violent exceptions connecting man with the lower animals. He lived in the hills of India, in Miocene days. His remains—such of them as we have—were discovered by Mr. Barnum Brown, one of the most indefatigable of explorers, who is on the staff of the American Museum of Natural History. He was a big fellow the size of the gorilla. The elevations and furrows on the crowns of the teeth follow so closely those of the Neanderthal man that Drs. W. K. Gregory and Milo Hellman of the Museum are inclined to regard dryopithecus as the closest approach yet found to the ancestor of the entire family of apes and humans. There are similar parallelisms between the teeth of the forest ape and those of certain Australian peoples, and others who are among the most primitive of existing humans. Dental comparison must be made on this basis, because the civilized white and yellow races have without exception lived for so many years upon a diet largely agricultural that great alterations in their teeth have taken place, masking their original characteristics completely.

THAT utter recklessness in the diagnosis and treatment of disease is not countenanced even under the loose license laws that permit the practice of various nondescript schools of treatment, was demonstrated in April in New York. A practitioner of what must be regarded as among the most respectable varieties of these medical hangers-on was called in to treat a little girl who, in point of fact, had diphtheria. The freak-o-path never found it out until it came time to apply for a death certificate, which very fortunately was the one thing that he could not supply himself. On the very clear basis of the post mortem diagnosis, plus the statement by the attending practitioner that he did not know what his patient was suffering from, a conviction of manslaughter was secured against the man whose mishandling of the case prevented the calling of a real physician until too late.

CHEMISTS from all over the country are gathering at Washington as we write for the spring meeting of the American Chemical Society, which will run from April 22nd to 26th. The keynote is to be given in two addresses of the opening day: "The Atom as Seen by the Physicist," by R. A. Millikan, Nobel prize winner and long time Professor of Physics at Chicago, and "The Atom as Seen by the Chemist," by G. N. Lewis, Willard Gibbs medalist and Professor of Chemistry at California. In addition to the discussion of atomic physics and chemistry, other topics which will loom large on the program will be industrial chemistry, alcohol manufacture, and helium production. There will be a spectacular display of the progress of chemical warfare

Telepathy and Radio

Results of the Scientific American Test of Thought Transference from the Broadcasting Studio

By J Malcolm Bird

ALTHOUGH the formal work of our Psychic Investigation Committee lies wholly in the field of the objective, the subjective side of the psychic picture is of sufficient interest and importance to justify periodic reversion to it So when opportunity presented itself to make an experiment in telepathy upon an unusual scale, through the WOR broadcasting station, we seized it. The general idea was for the members of the broadcasting group to fix their attention upon simple words pictures ideas etc and for the members of the radio audience to try to reproduce these This, of course is the traditional technique of telepathy experiments the only novel feature was the use of the radio

The philosophy that dictated this choice of medium has been much misunderstood There is temptation to argue that telepathy must be effected by transfer of energy from brain to brain and once we have said this, we are bound to talk about waves and to draw analogy with the light wave and the radio wave Now it would be among the *a priori* possibilities that telepathy is an electromagnetic phenomenon and in this event there would be good prospects that the radio wave might act as a "carrier" But it was not for this reason that we worked over the radio

The fact is, with telepathy as with other psychic manifestations, those in best contact with the phenomena are inclined to regard them as relativistic in their *modus operandi* That is they are looked upon as something to which the ordinary categories of time and space are not applicable, so that the attempt to formulate them in terms of these classical concepts would be as futile as though we were to try to define the color of a sound wave or an electric current If this idea is correct there is no reason to anticipate that the presence of the radio wave would have any effect good or bad, upon the attempt to communicate telepathically

Telepathy vs. Guessing

Now this attempt is easily made, but to estimate the success attained is highly complex Suppose that I think of the name of a certain city and suppose, for statistical exactness this be one out of a list of fifty Suppose I ask you to try to duplicate my thought Obviously, in response to this, the name of one of these 50 cities must come into your mind If you don t get the right one telepathically you must get the right or a wrong one out of your own psychology If you were an unthinking machine, we should know that the chance of your naming any particular city was exactly one in 50 But you are not an unthinking machine, *you have associations* with some of these cities that bring their names into your mind more easily than those of the others How then are we to estimate the chance of your naming New York or Galveston rather than Albany or St Louis?

When we come to actual scoring of a series of such tests, this factor works both ways. If my choice runs toward cities that are natural psychological choices for you you will score more hits than you are apparently entitled to, and I shall suspect you of telepathic sensitivity when you are innocent of this. If, on the other hand, I habitually name cities that are unnatural for you to name, your guess-work score will be so low that you may actually have considerable telepathic success without running sufficiently over the apparent mathematical probabilities to attract my attention

The mere fact that we must get a lot of data before we can apply the theory of probability, plus the complication which comes from the addition of psychological probabilities to mathematical ones, requires that we experiment a great many times with the same subject, or experiment once or oftener with a great many subjects, before we attempt to formulate results. The radio affords a means of experimenting simultaneously with a very large number of subjects so that a significant array of data may be got together in a minimum of time And of course, it also affords a very promising possibility of uncovering a few noteworthy telepathic sensitives Of the hundreds who respond, few, if any, have any idea whether they are sensitive or not. Of those who get several items right on the list of a given evening, further individual investigation may identify one or more as promising material for further work

Though this test was engineered by the Scientific American as such, and not by our psychic committee, we had the cooperation of Drs Murphy and Carrington of the committee At a previous test in Chicago, by Dr Murphy and others, there had been a battery of forty-odd 'senders' The idea was that we don't know what constitutes a good "sender" so the bigger the crowd the more chance of getting at least one good one But with so many present, the numbers, words and pictures whose transmission was being attempted had to be posted on a blackboard, where the reporters, among others, could see them Though pledged to secrecy, the gentlemen of the press began publishing the correct answers at noon on the following day, so all replies post-marked later than this had to be discarded In our own case, we decided to operate on a basis that would insure secrecy in the studio, so we used four senders against all of whom some suspicion of telepathic sensitiveness might fairly be held.

THE SEARCH FOR TELEPATHISTS

Test Number	Correct replies	Chance of getting another correct answer	Subjects who should have another by chance	Subjects who did have another
2	2	48	1	1
3A	78	37	29	17
3B	3	48	1	0
4	3	48	1	0
5A	8	47	4	3
5B	100	.31	81	31
5C	25	45	11	16
5D	11	47	5	4
6	3	48	1	1
7	14	47	7	5
8	9	47	4	8
Totals			86	74

The above table summarizes the results of the examination of the returns from those subjects who got more than one test right. It shows that the people who got one test right displayed, in general, no more tendency to get something else right than did the bulk of the respondents. The exception to this in the case of Test 5C is given an increased potential significance by the fact that it was this test which, considered on its own merits, most strongly suggested that telepathy may have been at work. The figures in the column "chance of getting another correct answer" represent the fractional probability of success in one attempt, with the omission of the decimal point, they would represent the probable number of successes in 100 trials

Trying to Telepathize

The procedure was simple Speaking into the transmitter, I said "For the first test, the members of the broadcasting group are concentrating upon a certain number between 1 and 1000 The members of the audience will try to get an impression of what this number is." The number in question (522) was written large on a slip of paper and during my remarks and for some seconds after, I and my collaborators concentrated visually and mentally upon it Of eight items on the program, one was double-barreled and another involved four separate answers so that in all, there were twelve opportunities afforded the members of the audience to be right or wrong At the end, they were asked to mail their memoranda of their results to me, and 480 of them did so The number would have been larger, had it not been for competition with two other local broadcasting programs, one cannot get undisputed possession of the New York air at any rational hour of the day or night.

Through failure to receive or to understand the question, or to get any definite impression, there were numerous blanks on single tests, so that the number of answers tabulated varies. Of 457 replies to the first test none gave the correct answer This is not surprising, since the mathematical probabilities of a correct guess were but one in a thousand. The number had been picked at random, off a letterhead, we were confident that it possessed no favorable or unfavorable psychological angles We were interested, however, to note that the only number getting more than one or two votes was 999, with more than a dozen This is doubtless because the more or less "occult" character of this number brings it easily to the mind, especially of people having some interest in occult things The same number dominated in the answers to the Chicago test.

One might incline to attach importance to answers that give one or more digits, correctly and in correct place Now I have a conversational trick of illustrating my remarks by a numerical example, with a definite number, chosen at random on the spur of the moment, and I have long been conscious that in these numbers there is a heavy over proportion of sixes and sevens. The Chicago tests ran heavily toward sixes, and there can be no doubt that in the general case, certain digits are psychological and others unpsychological. So conclusions regarding digital success should be drawn with much reserve.

The importance of avoiding a heavily psychological selection of the item for transmission is well illustrated here Of those who answered "999," all would presumably have given this answer whatever our number were Where should we have stood in rating this test, if our number had been 999?

For our second test, we used the outline map of one of the 48 States, asking the audience for an identification. Though chosen at random from a pile, Indiana turned out to be an unpsychological selection, of 470 answers, instead of ten correct ones we got but two, while of those who availed themselves of the opportunity to name two items if they got two approximately equal impressions, three gave Indiana with another State

Now one picking a State out of his own psychology will usually hit the State of his residence or an adjoining one, or if he dodges this pitfall, he is very likely to take flight in fancy clear across the continent, coming down in Florida or Texas or California Indiana then occupies an in-between position, and is an unnatural choice

Test 8 was double-barreled We used the front page head and date-line from one of the New York newspapers, with the advertisement of a certain department store We asked the audience to name the paper (the *Times*) and the store (Saks) Here, obviously, unless one displays real strength of character, one will name one's usual paper and one's usual store. In any event, a lot of people must have the paper right, since there are few alternatives, so it is not at all surprising that 78 respondents out of 448 named the *Times* The mathematical and psychological probabilities would depend upon numerous factors, but if these were estimated, they would give a figure not far removed from the actual score There is a distinct drawback in using a test for which the possible choices are so restricted Any *small* number of telepathic successes is bound to be swallowed up and lost in the statistical nature of the case; and one hardly expects enough telepathic successes to alter the score materially from what chance would dictate.

Examples in Psychology

The choice of Saks was, of course, an unpsychological one—in fact, deliberately so The three stores with the largest clientele are undoubtedly Wanamaker, Gimbel and Macy; and I purposely avoided these. By far the larger part of the replies was divided among them; Saks was named only three times.

For the fourth test, I shielded my watch from my eyes and turned its hands rapidly and at random. The four senders concentrated on the time at which it stopped, and tried to put this across to the audience. This test was certainly free from psychology in the

(Continued on page [illegible])

Our Abrams Investigation—IX

Results of Tests with Genuine E.R.A. Apparatus and Genuine E.R.A. Technique

By Austin C Lescarboura

Secretary to the Scientific American Abrams Investigation Committee

FOR the past four months or more certain electronic societies and associations have been engaged in forming special committees and formulating conditions to the end of actively cooperating with us in our investigation of their methods. Long before now we were given to understand that carefully selected electronic practitioners would be assigned to the task of undergoing our simple tests. Indeed, with a view to facilitating such cooperation, we went so far as to outline the probable nature of our tests, with the result that many of the electronic workers tried similar tests and determined for themselves just how scientific their methods were and how much they could hope to prove before an impartial body of investigators.

Meanwhile, time flies Month after month goes by We are asked to wait for this and wait for that. We are told that the technique is not quite perfected to the point where our simple tests can be undergone with a fair degree of certainty as to results. Also, we are warned again, the E. R. A and other electronic workers must be assured that we are really sincere investigators before they can entrust their work and their reputation in our hands. And so it goes.

But this committee, engaged for the past eight months in investigating the startling claims of the late Dr Albert Abrams of San Francisco, and his thousands of followers both here and abroad, cannot wait indefinitely Were we asking for some highly intricate demonstration of electronic technique, there might be fair cause for delay, but when it is borne in mind that we ask merely for a simple check-up on everyday electronic diagnosis, the case is quite different.

If, in the opinion of the electronic workers, their methods are insufficiently developed at this time to pass a most elementary test such as we propose, then in good faith and through honesty of purpose they should, without further delay, suspend their present electronic practice They should tell their patients that they are not sure just what they are doing After all, human life is too precious to be the subject of raw experimentation or something worse than that, as the case may be

All the while, our committee proceeds in the quest of truth. During the past few months we have been in constant touch with a group of doctors engaged in studying and applying the electronic reactions to their own technique and practice. These doctors, who are well known but whose names are withheld in accordance with our practice in this investigation, have taken the authorized Abrams course of instruction in San Francisco and are equipped with the genuine Abrams apparatus. For the purposes of our series of tests, they followed the simon-pure Abrams technique. Although these same doctors are the sponsors of an impressive report which endorses the basic claims made for the Electronic Reactions of Abrams—a report, by the way, which is being widely used and misused by the E R A men— they have displayed the utmost willingness to cooperate with us in every way because they themselves are still engaged in experimentation As the result of our series of blood specimen tests, reported in the following the spokesman of this group writes: "What you have done already with us demonstrates that we, at least, are not able, with the equipment we have, to pick out the same bloods." And that statement speaks volumes.

Tabulated Readings for Blood Specimens in the Attempt to Group Those of Identical Source

RATES	SERIES I Specimens No 1	No 4	No 5	SERIES II Specimens No 1	No 2	No 3	No 4	No 5	No 6	SERIES IV Specimens No 3	No 4	No 5	No 2	No 1	No 6	SERIES V Specimens No 2	No 4	No 6	No 3	No 5	No 1	SERIES VI Specimens No 4	No 3	No 6	No 1	No 6	No 2
57	23	22	21	44	4	4	14	13	20	13	11	11	11	33	12	24	32	31	32	34	34	21	23	33	31	21	20
55	0	2	0	11	4	4	4	1	13	12	2	2	1	1	1	11	11	1	12	23	22	11	13	11	4	3	2
53	0	2	0	6	3	2	4	1	4	3	1	2	2	0	2	0	3	2	3	1	3	0	0	0	1	1	1
50	1	0	1	1	1	1	2	1	15	1	0	0	0	3	0	0	1	0	0	0	2	0	0	0	0	0	0
60	4	4	4	4	1	3	1	2	19	2-25	2-25	1	3	3	1	7	3	1	3	2	4	1	1	1	2	3	3
42	3	1	2	1	2	1	1	1	3	0	0	0	0	1	2-25	0	0	0	2	1	3	0	0	1	0	2	0
40	L	R	R	L	L	L	L	R	R	R	L	I	L	L	L	L	R	L	R	I	I	I	R	L	L	R	R

Once we had agreed with these doctors upon the abstract proposition of a test in which they would attempt to identify blood specimens of common origin, we called upon Mr. Bird as the staff mathematician to define the procedure Obviously, the fewer specimens we use in the test the more often we can carry it out in a given time, and Mr Bird advised that six specimens would be the smallest number that would enable him to guard sufficiently against the operation of chance. He also recommended that of the six three be identical while the other three be 'singles,' differing among themselves as well as from the identical ones Any other course he advised, would greatly complicate the mathematical control of the tests, without yielding compensating advantages.

From six specimens three may be chosen in exactly 20 different ways Of these 20 combinations one and only one, obviously will comprise the three of identical origin. Nine of the remaining combinations will associate two of the identical specimens with one of the "singles"; and the remaining ten combinations will consist of specimens, no two of which are in fact identical

Speaking mathematically then and assuming that the choice is governed by chance alone, if this test were repeated 20 times, there should be one complete success, nine partial successes, and ten total failures. If we try the thing 20 times or more, we may expect that this ratio of 1.9.10 will be approximately realized. If we try it just a few times, we may expect that we will get perhaps one full success but hardly any more than that while the rest of the trials will be split about evenly between complete and partial failures. The electronist must get considerably more than one full success per 20 trials, and very much more than nine partial successes per 20 trials before he will have done anything tending to support his claims.

The late Dr Albert Abrams diagnosing a patient's condition from a blood specimen by means of resistances boxes and the abdominal reflexes of a boy reagent

Complete electronic diagnosis involves the recording of the ohmages for a large number of rates. The identification test, however may be confined to such few selected rates as the electronist judges to be sufficient to distinguish between two individuals. The alleged sex rate, which is claimed to be found on the reagent's left side for a female subject and on his right for a male, will naturally be one of these In addition to it, the doctors with whom we were working chose the rates 42, 50, 55, 57, 58 and 60 as an adequate set In this test of course, no reference need be made to the alleged pathology of these rates under the Abrams system

A series of tests consists in the determination of ohmages for the six rates and location for the seventh, for all six of the specimens provided Series I, II and III were prosecuted on the first day, with a set of blood specimens provided by the health authorities of New York State through the courtesy of Dr William H. Park At the second meeting a single Series, IV., was carried through, with specimens provided by the electronic experimenters themselves. Series V and VI occupied the third day, with a fresh set of specimens provided by the doctors.

Rearrangement of the Figures for the Purpose of Facilitating a Check Up

RATE	IDENTICAL SPECIMENS SERIES I II III No 1	No 1	No 2	No 5	No 5	No 5	SERIES IV No 3	No 4	No 5	SERIES V, VI No 1	No 1	No 3	No 3	No 6	No 6	ISOLATED SPECIMENS SERIES I II III No 3	No 3	No 4	No 4	No 4	No 6	No 6	SERIES V VI No 2	No 3	No 4	No 4	No 5	No 5
57	22	44	4	21	13	23	12	11	11	34	21	32	23	21	33	4	13	72	14	24	20	14	24	20	32	21	34	21
55	0	11	4	0	1	0	12	2	2	22	4	13	13	1	11	4	1	2	4	15	13	3	11	2	11	11	23	3
53	0	6	3	0	1	1	3	1	2	3	1	3	0	2	0	2	1	2	4	1	4	1	0	1	3	0	1	1
50	1	1	1	1	1	1	1	0	0	2	0	0	0	0	0	1	3	0	2	1	15	1	0	0	1	0	0	0
60	4	4	1	4	2	4	2-25	2-25	1	4	2	3	1	1	1	3	3	4	1	1	19	1	7	3	3	1	2	3
42	2	1	2	2	1	1	0	0	0	3	0	2	0	0	1	1	1	1	1	1	3	2	0	0	0	0	1	2
49	L	L	L	R	R	R	R	L	L	L	L	R	R	L	L	L	L	R	L	R	R	R	L	R	R	L	L	R

In every instance the specimens carried blind identification numbers. In Series I to IV nobody present knew which specimens were identical until the key was consulted at the end On the final day, Mr Bird consulted the key list from this

(Continued on page 436)

Getting Together on the Traffic Problem

The April Conference, at Yale, of Those Expert in All Its Branches

By the SCIENTIFIC AMERICAN *Staff*

ONE of the first impressions that one gets from any survey of the motor traffic problem is that of its complexity. The mere statement of the problem is almost a sufficient indication of this complexity. Further evidence is given by the extraordinarily diverse treatment which different States give the same point, and by the extraordinarily diverse content of the motor codes of the several States, many of them touching in great detail things which are not at all the subject of legislative enactment in others. Then we have the Motor Vehicle Commissioners of ten eastern States, after several years of close association and contact in an organization whose whole business is the attainment of uniformity, totally unable as yet to agree among themselves as to the best means to certain necessary ends.

Such a complex problem is to be resolved into its elements, if at all, only after a great deal of open discussion by a great many very competent people and after a great deal of publicity. A long step in the attainment of both these ends was taken in the conference on Motor Vehicle Traffic, held at New Haven under the joint auspices of Yale University and the State of Connecticut April 9th to 11th.

According to the statement made in the invitations sent out, the purpose of the conference was to consider the causes of accidents due to motor vehicle traffic, and to discuss methods for preventing such accidents. The machinery of the conference consisted in addresses followed by general discussion. The first day's program revolved about a study of the conditions and a statement of the problem. The keynote address, and at the same time the most important single contribution, was delivered by Professor John C. Tracy, of the Department of Civil Engineering of Yale University. Professor Tracy and his colleagues were called in some time ago by Commissioner Stoeckel of the Connecticut Motor Vehicle Department. The Commissioner's office, since the installation of the compulsory reporting of accidents which we described in the SCIENTIFIC AMERICAN last month, had accumulated data regarding 15,000 accidents. The big feature of this was that the accident roll involved was complete—they were not accidents selected out of a larger total, but included all Connecticut's accidents for three years. The Commissioner's office knew that there was great value in this mass of statistics, but did not know how best to get it out, and every attempt that they made to analyse them figures led them into worse uncertainty. Did the figures mean this, that or something else? Finally they got the Yale engineers on the job, and the result was a really brilliant analysis, and the most striking graphical presentation which we have ever seen given to a mass of data of comparable size. Professor Tracy's talk and the ensuing discussion took up a whole morning, and nobody begrudged the time.

For the afternoon of the first day, there were two addresses. Judge W. M. Maltbie, of the Superior Court of Connecticut, talked about "Laws Governing Traffic", and T. W. Salmon, Associate Professor of Psychiatry at Columbia University, discussed "The Mind of the Operator." The titles define these papers sufficiently for present purposes, so no further comment is made upon them, other than to remark that Professor Salmon's theme, the uncertainty and the fallibility of the human element ran through the entire conference, and was stressed by many speakers as constituting a dominant aspect of the whole traffic problem.

The character of the accidents that are occurring, the character of the regulation that is being attempted, and the character of the human mechanism involved in the driving of the car having been duly placed on record the second day of the conference was given over to talks dealing more or less directly with the ways and means of prevention. A. B. Meredith, Commissioner of Education of the State of Connecticut, discussed the remedial value of education, as applied to the child. E. G. Payne, Professor of Education at New York University, took a more general view and outlined the value of education applied to the general public. Both these speakers stressed the fact that the habits and customs of a former day which are more or less ingrained in us, are unsuited to the present era, and that we are unsafe on the public ways in direct proportion to the extent to which we permit these habits and customs to control us. In the child, it becomes actually necessary to overcome tendencies of biological origin before the menace of the automobile can be eradicated. The importance and the diversity of this element, one must conclude after listening to these two addresses, is seldom if ever realized by the world at large. We must choose between our cars and our fathers' habits of mind.

The subject of education having been thus covered, Colonel F. S. Greene, Superintendent of the Department of Public Works of the State of New York, in charge of all road construction and maintenance in the Empire State, talked on "Highway Improvement." He pointed out, as we did last month, that while in a majority of accidents some reckless or improper or ill judged act by the operator is the immediate cause, the fact that wrecks are not scattered freely and uniformly all along our highways proves that usually there is, in some physical feature of the road, a contributing cause without which the accident would not occur. And, as a road maker, he is willing to shoulder the burden of removing these physical peculiarities, of making the roads as nearly fool proof as they can be made. He gave in considerable detail the essential characteristics, as he sees them, of a road that shall be safe for automobiles traveling at speeds of 35 and 40 miles per hour. His paper was followed with the keenest of interest and attention—presumably because everybody has his own opinions about road-widths and curves and grades and shoulders and danger signs, and everybody wants to see how closely the expert approaches to his own high standard of intelligence. Incidentally the Colonel gave another demonstration, if another were needed, that experts don't always agree among themselves. He had driven from Albany to New Haven, and had seen several things on the Connecticut roads which he criticized as undesirable—at least one of them being among the most cherished innovations of the Nutmeg State's road-builders!

The afternoon of the second day was given to a paper on Traffic Regulation and Control by W. P. Eno of Washington, D. C., one on Police Methods by A. F. Foote, Commissioner of Public Safety of the State of Massachusetts, and one on Laws and Court Systems by D. A. Adams, Secretary of the New Haven Automobile Club. Commissioner Stoeckel closed this session with a brief summary, and a recommendation that a permanent organization of the conference be effected. This is to be carried out.

On the third day, Commissioner Dill, of New Jersey, outlined the procedure of a motor vehicle department, as exemplified mainly by the things which his does, and in some lesser degree by those he would like to have it do. The balance of the day was given to problems peculiar to Connecticut, highways, street railways, public service motor vehicles, traffic policing of highways and traffic policing of city streets being the points discussed.

Much of the material brought out at the conference will be available, a little later on, for our use in the preparation of special articles going with considerable detail into the matters specified by the titles. For the present, we are content with this brief statement, because the conference was of such importance as to demand attention in this issue, and nothing beyond this brief statement can be prepared in the very short time remaining before we go to press.

Walking on Red Hot Stones

IN some parts of Asia the priests, in order to show their magical powers, walk on red hot stones. The stones are spread over a fierce fire and the men then proceed to walk over them without any protection to their feet at all. This achievement has always puzzled scientists a great deal for there is no doubt that the priests really do walk on the stones with bare feet and also that they do so without injury. Many times the feet have been closely examined after the ordeal and have not shown any signs of being burned at all.

It has been stated that the soles of the priests are much tougher than would be the case with men accustomed to wearing boots. No doubt this is true, but even the toughest skin would soon be burned by the fierce heat. The real explanation is very interesting and has only just come to light.

In the making of a fire a shallow pit is dug and in the bottom of this is placed the wood. This is overlaid with several layers of round stones and the fire is lighted. When everything is apparently at a great heat the priest walks across, and gets to the other side quite unharmed. Any sceptical person who tries to do the same gets his feet terribly burned. It has been discovered that, always, at these times one kind of stone known as basalt is used. This is of volcanic origin and is extremely porous and moreover is one of the worst conductors of heat known. It is quite possible to have a lump of basalt red hot at one end and yet cool enough to hold in the hand at the other end. Thus the cunning priest knows exactly where to put his feet and as long as he actually avoids treading on the glowing stones there is no fear that he will get burned. Anyone who does not understand the trick would walk carelessly with very painful results.

The Locomotive of the Future

IT IS far too readily assumed, especially by non-technical people, that all the great railways will eventually be electrified. However, among the chief drawbacks to the realization of such assumption are the very high initial cost, approaching a rebuilding of the railroads, and the very serious risk of breakdowns, which may even paralyse the whole system, instead of a single train as with steam.

Viewed sentimentally, the heavy and cumberous electric locomotive cuts an ignoble figure as a mere transmitter, not a producer, of power.

Can the ultra-reliable steam locomotive meet the challenge of this comparative newcomer for the dominion of the iron road?

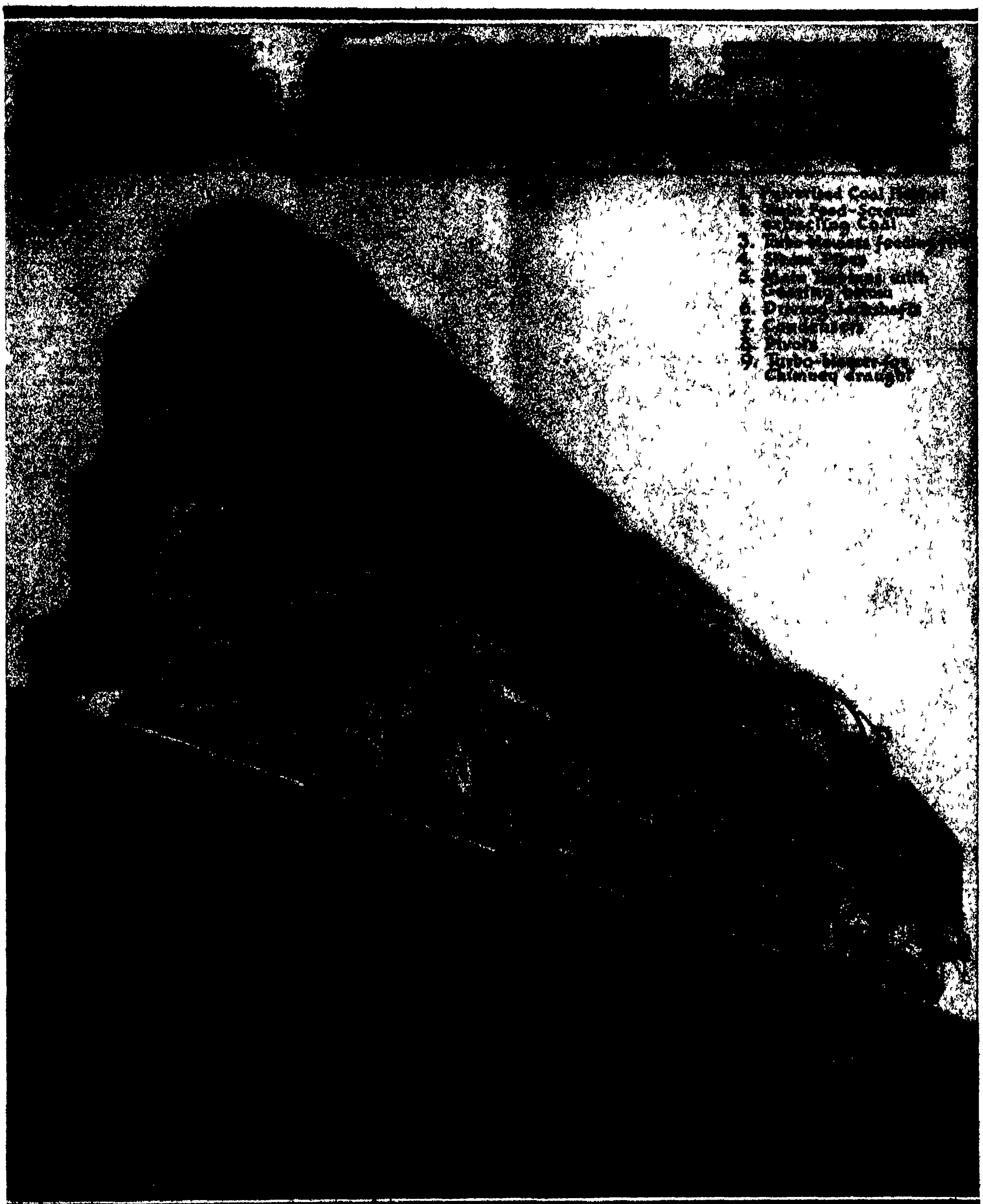
The simple steam locomotive of today is undoubtedly touching its limit, and is extraordinarily wasteful, putting only some 6 per cent of its heat to actual use. It has never previously had a condenser, as in other steam practice, which simply means extracting further service from the inadequately used steam by returning the condensate water, still heated, to the boiler. Compounding, also, has failed, being the using over again of the steam in a second, larger cylinder at a lowered pressure, these cylinders having grown too big, in the most powerful examples, for the limits of space.

However, the success of the Ljungström turbine-driven locomotive, recently described in these columns, has opened a vista of increased power and economy. This design, which employs a large condenser that disposes of the used steam practically in its entirety, and gearing to reduce the speed of the turbine to that necessary for the wheels, has equalled the results of equivalent standard locomotives on just half the fuel.

Further promise in the same two directions is held out by the articulated locomotive, which has two engines of the present reciprocating type under fore-and-aft coal and water tenders, and a central boiler section on a girder frame hung from two pivots, one above each set of coupled driving wheels. This type, first designed to negotiate sharp curves and steep gradients, has been highly successful in the British Colonies. Its power is much greater and its fuel consumption less, the boiler being broader and therefore more efficient, the fire-box, uncramped by the usual wheel axles below, larger and of better shape, while the articulation allows of greater length and steadier riding, with higher speeds round curves.

Finally, economy can be further improved by the use of pulverized coal, in which combustion is much more complete, with reduced smoke and ash and better steam-raising, the results equivalent to standard being obtained with inferior fuel, and mechanical stoking.

The prophetic drawing on the facing page depicts, in two views and a section, all these desirable features incorporated in one locomotive as a possibility of the future. Our artist's design is based upon the Swedish Ljungström Turbine Locomotive, the Garratt Articulated Locomotive, the G. C. Rly. pulverised coal burner No. 422, and feed from the front of the fire-box as in the Paris-Orleans oil-fired No. 4593. Such a locomotive would probably be 100 feet long, certainly weigh over 200 tons, would multiply the power of our present powerful locomotives several times, with only a relatively small increase in fuel consumption, and would haul several times the current train loads at express speed. Such an engine could, owing to the articulation, moreover, do all this quite as safely as existing engines, without any strengthening of track or bridges.

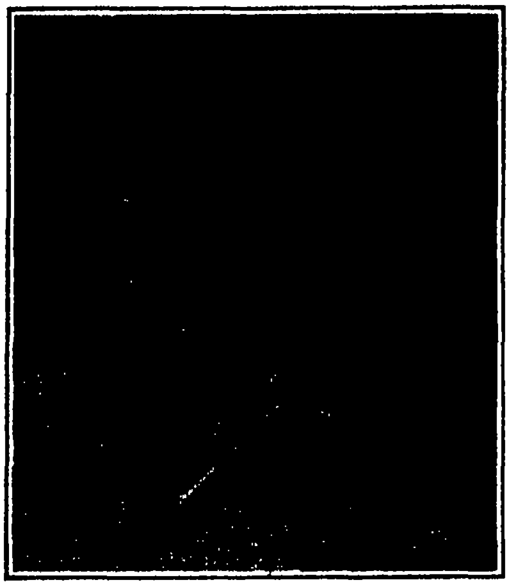


STUDY OF A TURBO-DRIVEN, CONDENSING LOCOMOTIVE OF THE ARTICULATED TYPE, FOR HEAVY EXPRESS SERVICE. IT INCLUDES A CENTRAL BOILER AND TWO CONDENSER TENDERS—(See facing page for description)

The Blast Factory

From Raw Materials to Finished Product in the World's Largest Dynamite Plant

By H E Davis



Bulk dynamite en route from mixing house to packing machines

APPROXIMATELY 326 000 000 pounds of dynamite were used in the United States during the year 1923 for upon the energy of explosives depends mining quarrying and other basic industries The manufacture of dynamite calls for raw materials from widely separated regions and the application of scientific knowledge and skill to the problems of combining them into explosive compounds which will be safe and effective blasting agents

The largest dynamite works in the world, located in this country, spreads out over thirteen hundred acres and includes plants for the manufacture of ammonium nitrate and nitric and sulfuric acid, and of the paper shells and wooden boxes in which the explosive is packed, storage magazines, the necessary facilities for power and transportation and a laboratory for analysis, testing and explosives research, as well as seven complete units for the manufacture and packing of the various kinds of dynamite—straight nitroglycerin, ammonia, nitrostarch and gelatin.

The dry ingredients of dynamite include nitrate of soda from Chile ammonium nitrate, wood pulp from Maine flour, starch, kieselguhr, sulfur from Louisiana and Texas, and ivory nut scrap from the Caroline Islands via the button and bead makers who cut their wares from the center of the kernel and sell the scrap to the dynamite manufacturers to be ground into a fine meal and used as an absorbent Some of these materials must be ground and screened before use and all of them are carefully dried

The manufacture of the dynamite itself starts with the nitration of glycerin This operation, like all others in the plant which are subject to explosion, is carried on in a house remote from other buildings and surrounded by wooden cribbed earth barricades. A weighed charge of mixed nitric and sulfuric acid, approximately 7000 pounds is brought to the nitrating house in a tank car and blown up from the car by compressed air into the nitrator on the second floor, a wrought iron cylindrical tank standing on end with several pipes leading into its cover and on the inside two overgrown ice cream freezer paddles in the center and coils of lead pipes near the shell When the mixed acid is running in, the paddles, operated by a small steam engine, are set in motion to circulate it around the brine coils so that it will be cooled to the proper temperature before the glycerin is added Meantime the required quantity of refined glycerin, about 1400 pounds, is blown by compressed air from a heating tank, where it is warmed to a temperature which will facilitate flow to a scale tank in the nitrating house whence it can run by gravity through a rubber tube into the nitrator When the acid is all in and cooled to the proper temperature the foreman takes his seat on a high stool near the nitrator, places the end of the rubber hose leading from the scale tank in a funnel in the cover of the nitrator and by means of a valve on the end controls the flow of nitroglycerin into the nitrator by hand The glycerin runs first into a perforated cast iron pipe just below the top of the nitrator and from this sprays down upon the swirling acid The nitric acid combines chemically with the glycerin to form nitroglycerin and water, the sulfuric acid merely serving to facilitate the reaction and to take up the water formed This reaction releases so much heat that unless it is carefully controlled there is great danger that the nitroglycerin will explode Consequently the charge is continually agitated around the cooling brine coils and the operator feeds the glycerin to the acid gradually, keeping an eye fixed on a thermometer extending up through the cover of the nitrator The most favorable temperature for nitration and the maximum allowable temperature have been determined by laboratory experimentation, and vigilant supervision is exercised to see that charges are run within this range

After the glycerin has all been fed into the nitrator a small quantity of kieselguhr and certain other substances is added to facilitate the separation of the nitroglycerin from the spent acids When the green light shows in the signal box in the corner of the nitrating house, indicating that the separating house is ready to receive the charge, the foreman opens an outlet valve in the nitrator and gradually decreases the speed of agitation as the charge now flows out

Separating house where the nitroglycerin is separated from the waste acid

From this upper room of the nitrating house a board walk on stilts, with a covered lead-lined nitroglycerin trough on the left and hand rail on the right, leads to the separating house about one hundred yards away This is the most hazardous operation in the plant but as one follows the narrow walk through the tree branchings with their leaves casting delicate shadows on the planks and a blackbird fluting melodiously in the sunshine, danger seems very remote and unreal In the dusky interior of the separating house stands a seven foot lead tub and nearby, to keep close watch on the nitroglycerin as it runs in, the foreman One separating foreman in particular always comes to mind when I think of this operation—a brown-bearded man with soft brown eyes Clad in greenish brown trousers, blue flannel shirt and dark red sweater, all faded by long exposure to acid fumes into dull harmonious colors, he looks for all the world like a figure out of a painting by one of the old Italian masters And indeed he seems, here in the dim quiet of his nitroglycerin separating house among the tree tops, solitary except for the presence of a single helper and the visits of superintendent and inspector, almost as much a recluse from the world as a holy man in some mediaeval monastery In reality, he is performing day after day a highly dangerous function in the manufacture of a commodity upon which our whole modern civilization with its great industrial plants, its complex systems of transportation and communication, and its high standards of domestic comfort, depends. Twenty nine years this man has worked on this plant and ten in this same house

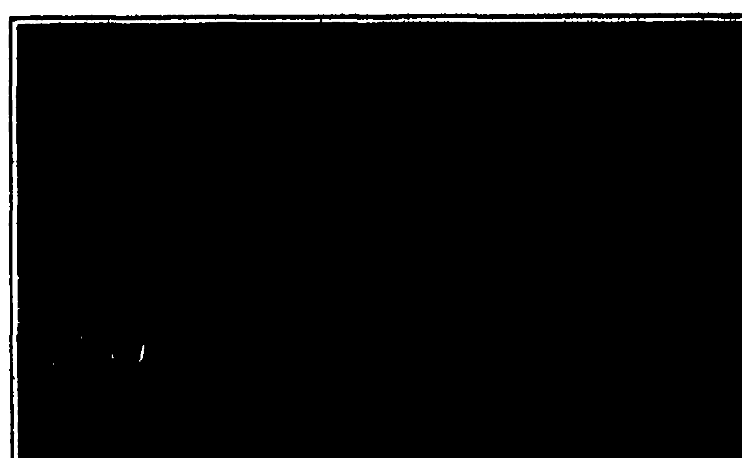
After the nitrator charge has run into the separating tub it is allowed to settle until a line on the sight glass in the side of the tub shows that the acid has sunk to the bottom and the nitroglycerin has risen to the top The foreman continually watches the temperature of both liquids so that if the temperature of either rises above the safety point he can turn on compressed air in the bottom of the tub to start agitation or can run the whole charge into the adjoining drowning tub

When the separation takes place without this emergency, as it generally does, the glycerin is drawn off into another tank and washed by agitation with warm water It is again allowed to settle the glycerin this time falling to the bottom, and then is run through the gutter along the plank walk which leads to the neutralizing house The spent acid is likewise run from the separator into another tank and then blown to a storage house, whence it eventually returns to the acid recovery plant in the safety area The acids are recovered fortified and used again

In the neutralizing house the n g as the nitroglycerin is generally called in the plant, is washed with a warm dilute solution of soda ash until it tests acid free, and is then piped into lead storage tanks on a platform along one side of the house From these storage tanks a weighed quantity of nitroglycerin is transported in a rubber lined and rubber tired push cart to the dynamite mixing house These n g carts are known on the plant as "angel buggies" and the men who push them are very careful not to exceed the speed laws, which call for a leisurely saunter

In the mixing house are two dynamite mixing machines, each consisting of a bowl of wood lined with hard rubber, about ten feet across and a foot deep, in which stand two parallel, rubber-shod wooden wheels, about four feet in diameter, attached

(*Continued on page 437*)



The mixing house, where the liquid nitroglycerin is mixed with the "dope," making dynamite. Note "angel buggy" at left

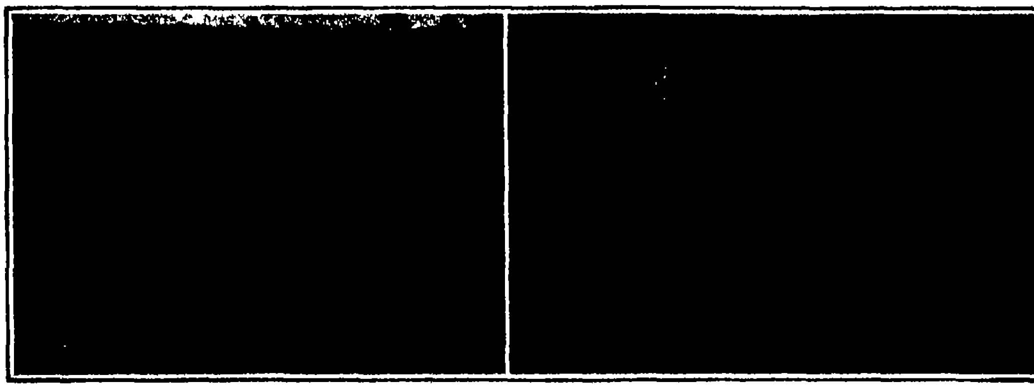
Railway Ties of Concrete for India's Railways

A CONCRETE sleeper, or railroad tie, has been developed in India and used with success on the Bombay, Baroda & Central India Railway, as well as on the North Western Railway

The sleeper consists of two concrete blocks joined together by an iron tie bar The method of fastening the rails is by spiking into wood pugs, which are inserted in the body of the concrete block The wood plugs are treated and dried down by a kiln process to a condition drier than the wood could naturally become even in the driest desert areas of India After drying it soon takes up atmospheric moisture and expands somewhat between and into the metal corrugations placed in the concrete blocks thus securely keying itself in. The plugs are compressed when driven and the efficiency of their grip on any form of spike—dog, screw or round—is much greater than in ordinary timber

Each sleeper block weighs 165 pounds and the complete sleeper weighs 350 pounds The concrete blocks are rectangularly ovoid in shape, rounded off in all directions and are without lugs, bolts or any upstanding parts liable to mechanical damage

The sleeper needs very little surfacing or packing to maintain a good road, this being due to the steadying influence of its weight and to the large bearing area on the roadbed



Left Concrete railway ties in use. Right Parts and reinforcements of concrete railway ties

The reduction of noise in any train when traveling from the ordinary wood road on to the concrete road is obvious to any passenger It is estimated that the concrete ties, with the stone for the aggregate selected for its hardness and cured for 28 days under water, have a life of about 150 years.

Disappearing Searchlight Towers

THE sixty inch searchlight used in seacoast work by the Corps of Engineers of the United States Army weighs with its electrical equipment about eight thousand pounds, and its light intensity is about one billion candle-power With a view to concealment and protection when it is not in use, there has been designed by Mr F D Cummings, Assistant Engineer of the Corps what is known as a "disappearing searchlight tower" Our readers are familiar with the disappearing mount for our seacoast guns, which makes it possible to load and aim the gun below the protection of the parapet, and expose it to the view of the enemy only at the instant of firing The new searchlight tower makes it possible to screen the light from horizontal observation by hiding it behind hills, mounds, trees, or even shrubs, and raise it into position only at such times and for such periods of time as may be desired

The towers vary from 45 to 100 feet in height Each consists of a frame built up of steel angles, with two short arms at its top with a swinging platform between, at the center of which is carried the searchlight Upon this platform the fixed portion of the base of the searchlight is firmly bolted down, and it is large enough for several men to move around the light and manipulate it in any direction.

Because of electrical considerations, it is desirable to have the rheostat convenient to the operator and hence the resistance sections are attached beneath the platform floor The platform with its light and connections is so balanced that, whatever the angle of elevation of the tower, the platform will always be maintained in a horizontal plane

The lower end of the searchlight tower is supported upon a trunnion shaft which journals on two A frames, between which the counterweighted butt end of the tower swings. Each A frame is braced by a third leg, and all three legs are securely anchored to a heavy masonry foundation. This butt end is counterweighted, mainly with concrete, which is cast into the steel frame and forms a rigid part of it

To compensate for variations in the loading of the searchlight platform, small blocks of concrete or cast iron are provided and these make possible a very exact adjustment of balance The trunnion shaft is keyed to the tower and its journals turn in bronze bushed bearings on the A frames Particular attention has been paid to the matter of lubrication, and compression grease cups communicate with grooves in the journal which sweep the entire lower surface of the bearing in its rotation from the horizontal to the vertical position

Great care has been taken to make the bearings self alining and non binding, with the result that hand power operation is easily effected even the largest one hundred foot tower being readily operated by one man The forty foot tower may be raised or lowered by one man in less than a minute, and the one-hundred foot tower by two men in less than two minutes To avoid complete breakdown, the operating mechanism is in duplicate

The balance of the operating platform at the upper end of the tower is such that it cannot overturn even with several men at one edge, but to prevent oscillation and maintain the platform horizontal under all conditions, the tower is provided with what is known as an "equalizer"

The tower can be securely held by brakes at any angle and these brakes can be padlocked in any position Moreover, when in a vertical position, the tower can quickly be made a fixed structure with a rigid platform, independently of the brakes and the equalizer It can be locked to the A frames, and the platform anchored to the tower simultaneously, by one movement of a lever at the ground When elevated, the towers are quite rigid and stiff against wind effects The moments of inertia of all the towers are relatively large and their centers of gravity quite near the ground

Disappearing searchlight towers for seacoast defense

When in the lowered position and not in use the searchlight is enclosed within a small steel house which moves on grooved wheels laid on the tower platform and on a foundation adjacent to the platform landing When the tower is swung down the house can be readily pushed forward on to the platform and over the searchlight The curtain door is closed and fastened inside, and the operator locks the small rear door from the outside With certain modifications this type of tower is used for a railway mount on a large flat car On such a mount it will form an important element of the coast-defense railway artillery possessing the same quality of invisibility

The plans for this tower were designed by Mr Cummings in the course of his governmental work and the development of these structures was initiated under Colonel E E Winslow Corps of Engineers United States Army

The Nerves of Plants

THE general similarity of the distribution of the fibro-vascular bundles in plants and that of the nerves in animals have been clearly noticed. These structures in plants have consequently, been called nerves. However, anatomists and physiologists alike have long held the view that the likeness is merely superficial, and is not based on any real physiological or anatomical resemblance

In plants—as in animals—the receptive and responsive regions are often quite distinct from one another, and may be widely separated What becomes of the stimulus between the two and how is it transmitted? Remarkable experiments during the last ten years have given the answers to these questions There is Ricca's work on the sensitive plant, Mimosa The phenomena of transmission of stimuli in this plant are as striking as they are well known. The stimulus is propagated through its organs at velocities variously estimated at 10-20 mm per second. This speed is fast among plants but very slow when compared with the velocity of transmission of stimuli along animal nerves

Two views were suggested to account for this propagation The first referred the passage of stimuli to those excessively fine strands of protoplasm which, penetrating the walls of the living cells, place the protoplasts of adjacent cells in communication with one another This view was a product of a period obsessed with the physiological importance of these then recently discovered protoplasmic fibrillae, which, in all probability, have only a developmental significance These fibrillae composed of living matter were supposed to convey stimuli just as the living processes of the nerve cells do in the animal body

The view was soon rendered untenable when it was shown that stimuli are effectively transmitted even after the protoplasm of the cells of the transmitting organs was killed by the application of heat

To meet this new growth of knowledge Haberlandt developed his theory, that the stimuli are transmitted in Mimosa in the form of a pulse in the water filling certain elongated tubular cells situated in the bast of the bundles At the best this was an unsatisfactory theory

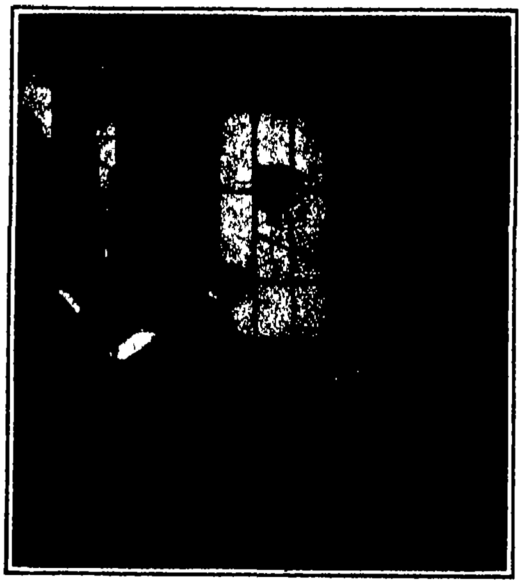
In 1914 Ricca gave the *coup de grace* to the pulse theory *He showed that the stimulus is transmitted* through a strand of Mimosa wood from which all the bast, including the tubes of supposed transmitting function had been removed from a considerable length

Almost at the same time as Ricca was disposing of the older views regarding the transmission of stimuli in Mimosa, Boysen Jensen was carrying out experiments on the phototropic reactions of seedlings, which were bound to have a profound effect on the received views regarding the propagation of stimuli

When the tip of a grass-seedling is illuminated on one side a stimulus is transmitted from the receptive region downwards in the seedling and evokes a curvature in the shaded part Boysen Jensen found that this stimulus was transmitted downwards even when the protoplasmic continuity of the cells of the receptive apex with those of the responsive region was severed by complete section

From this experiment and similar experiments by Stark Snow and others it is quite evident that protoplasmic continuity is not requisite for the transmission of stimuli in the higher plants

There is great probability that in these plants as in Mimosa, the transmission of stimuli is effected by the transport in the transpiration stream of a substance derived from the receptive cells and conveyed by this means in the wood of the vascular bundles to the responsive region Response is probably evoked by alterations in permeability —*Abstract from article by H H Dixon F R S in Nature December 1, 1923*



Measuring a wire-glass window for distortion, after one hour's exposure to intense heat

Studying Fire Risks from Sample Fires

How the Behavior of Columns and Beams Under Exposure to Conflagrations Is Determined in the Laboratory

By J F Springer

IN the modern American methods of building construction, the column plays a most important part. Many structures are so designed that the walls carry little or no weight but on the contrary constitute loads which must themselves be supported. But even in those cases where exterior walls support the outer ends of girders these same girders are intermediately carried by something else. In short the tendency is to provide columns both for use in the interior parts of buildings and also for use in the regions where the walls are located.

The steel column is one form. It may rest upon a general foundation or upon a special pier of its own. It may extend upward to the top of the building and at every floor may partially support one or several girders. Sometimes columns are supported by heavy girders, especially where some unusual element has to be cared for in the design. In the construction of the great Woolworth Building in New York City, certain piers were already sunk when the site was enlarged and a relocation of columns became necessary. And so it came about that some columns rest not directly upon piers but upon girder construction connecting piers. In the Bankers Trust Company building and also in the Aeolian Building, both tall structures in the same city, one or more large rooms were desired where certain columns would be eliminated and a clear space provided. As these rooms were to be at low levels, it became necessary that overhead girders should supply foundation support for columns running all the way to the top of the building or up to a high level.

The cast iron column has ordinarily a more modest function than the more considerable steel columns in that it will usually be a short affair. Reinforced concrete is another type of modern column. In this the compressive load is carried by the concrete and buckling and the like are prevented largely by the steel reinforcement. There is however still another type of column which consists of steel work designed to carry *the load or the most of it* but which is enveloped in concrete or some other fire-resistant material. Wooden columns are also in use. In fact it is hard to drive wood from construction work because of the fine resistance it presents to many destructive activities when it is properly installed.

Concrete is resistant to fire and to water. This combination seems a good one when we contemplate the hazards of fire. Steel is also good but unfortunately it is liable to soften and bend under the influence of heat. We might raise the question What will be the behavior of a given column when subjected to the heat of a conflagration and to the attack of water from fire hose when the column itself is heated? Questions such as this may seem very academic to the general public. But they are not so to those who like the fire insurance companies contract to make good the damage caused by fire. These people want to know and in fact they need to know.

So, a few years ago certain people having business reasons as an incentive and the U S Bureau of Standards co-operated in an effort to find out the facts, or a part of them. A series of tests was made, one hundred and six in all which were directed towards the ascertainment of the behavior of columns exposed to fire while under a load of the kind imposed when they are suitably installed in buildings. The columns were uniformly 12 2/3 feet in effective length and were designed to carry a load of 100,000 pounds. Some of the columns were steel some cast iron some steel pipe filled with concrete, some reinforced concrete and some wooden. In respect to length and load capacity, these 106 columns were representative units used in interior construction. Some of the columns were more or less protected by concrete, plaster and the like.

In order to imitate the conditions of a fire the columns were tested in a gas furnace while under load. It may be seen from this combination of heat and load that the tests reproduced important conditions that would exist in an accidental fire or conflagration. Indeed, some of the columns were subjected to the impact of a stream of water while they were under load and in a heated condition. We have here the principal conditions existent in a fire after the lapse of a little time.

The wall carrying this frame is movable. It has just been subjected to intense heat after which it has been moved to its present position and a stream of water turned upon it in imitation of the sequence of exposure at a real fire

Testing the fire resistance of a metal window frame

Those who constructed the building may have been satisfied with columns that carried their loads and would continue to carry them under the ordinary conditions of life. The insurance companies seem to want something more. Apparently they want columns that will stand up and do their duty in spite of fire and water. An unprotected steel column may be economically built to sustain the proper load under usual conditions but the tests show that when such a column is subjected to the hazards of fire exclusive of water it will probably fail in twenty minutes. Steel with all its strength and other admirable qualities seems to be, when used alone one of the most inadequate of modern construction materials. Cast iron unprotected is better and a good deal better since it can be counted upon for 35 minutes. The unprotected wooden column proved somewhat better yet since it held out for 40 minutes. This seems surprising no doubt, to most of my readers. Wood is a very good construction material and is when used where it is continually submerged, almost indestructible. This has been understood to some extent by contractors having much experience with wooden piles. When wood suffers it is usually some organic enemy that is at work. The star performers, however, in the fire tests were columns constructed of reinforced concrete and columns having a 4-inch protective envelope of concrete. These withstood the fire for eight hours.

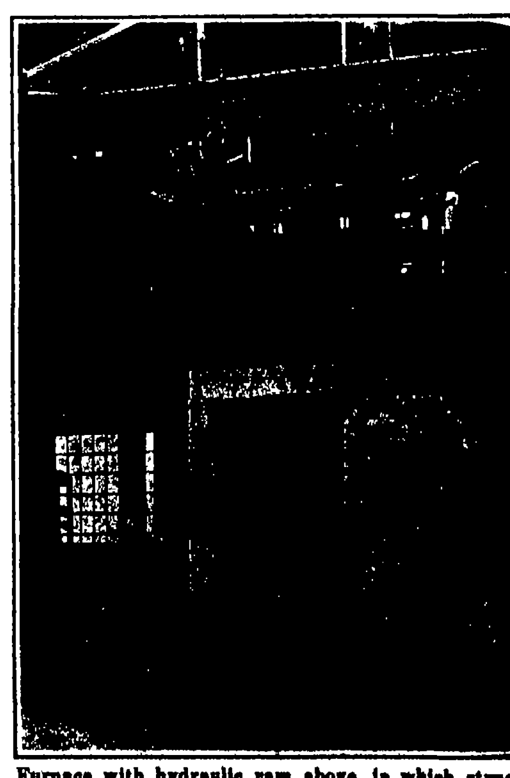
In a notable fire which occurred early in 1922, a spectacular view of the collapse of a building was presented. The Atlantic Building, in Chicago, was seen to lose portions of the outside wall. Now a portion would fall from one of the stories, now a portion from another story. The steel columns sagged and at last the remainder of the structure fell in a heap before the eyes of the onlookers. The insurance companies want something a good deal better than this. They apparently want the builders to put up structures having a good deal more of resistive power.

In one of the illustrations is shown a testing installation capable of producing the heating effects of a conflagration plus the compressive effects of a heavy building. The furnace door is open. In the compartment may be placed the column to be tested. Above is a hydraulic ram capable of exerting a downward thrust equivalent to the weight of 250 tons. Many thousands of dollars were expended on this equipment. In connection with it, instruments may be used for determining with precision the load actually sustained by the test column for ascertaining the temperature inside the column and for measuring the amount of sag, bend and shortening.

While the column is exposed to heat and pressure, a representative fire stream of cold water may be turned upon it and the effects noted.

It will be recalled that timber columns, while better than steel or cast iron, all being unprotected, did not *show up so well in comparison with other kinds of columns*. The lumber people became concerned over the poor showing of wood in such cases. It seems that for what is termed "mill construction" timber columns of high class had been enjoying a good reputation. Certain sample columns were expected in the test to sustain for one hour a standard load while surrounded by a fire whose temperature was being advanced at a standard rate. They did not stand the test for the expected period. They failed in half the time. Experiments were conducted for the purpose of finding out what was responsible. The wooden columns were observed to fail *at the ends*—not in the intermediate portion. At the end the material appeared to suffer first a slow crushing then a rapid one. There was perhaps

(*Continued on page 438*)

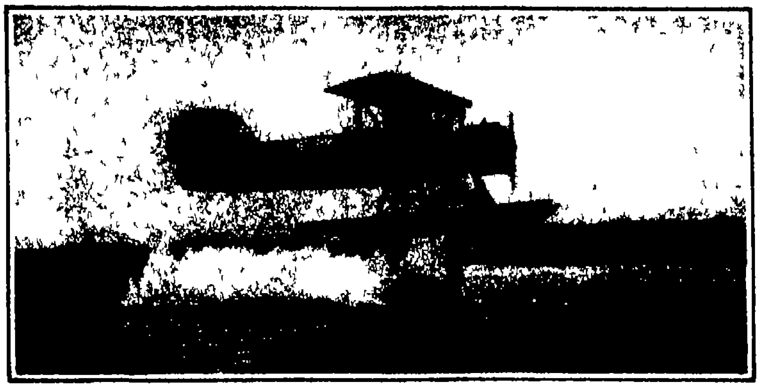


Furnace with hydraulic ram above, in which structural units may be subjected to great heat and extreme pressure combined, as they are in the lower stories of a burning building

Torpedo Attack by Airplane

WHEN it was suggested several years ago that torpedoes could be launched from airplanes, the idea was received with doubt, if not with derision It was urged that a torpedo weighing a ton or more was too heavy to be carried, and that to send it crashing into the sea from a height of many feet and at a speed of sixty to seventy miles an hour would surely disorganize the delicate controlling mechanism, upon which the accuracy of the torpedo depends

Despite these early misgivings torpedoes of large size are now being carried by torpedo-planes and launched with an accuracy which establishes this new form of attack as a serious menace to the battleships and the larger cruisers



Splash of the torpedo as it is dropped from torpedo plane

The torpedo is held in stirrups below the body of the airplane and at the desired moment is released by the pull of a lever Before letting it go, the plane is levelled out so as to insure that the torpedo will strike the water in the proper position The releasing of the torpedo trips a lever that opens a throttle between the compressed air chamber and the turbine which drives the propellers

The advantage of airplane over destroyer attack is found largely in the great speed and maneuvering ability of the airplane A squadron of these moving out to attack, would approach at high elevation swoop down to within the chosen firing range and when the planes were 15 to 20 feet above the water they would drop their torpedoes and try to make the best of their way outside the range of the enemy fire A direct attack in daylight would obviously be full of hazard, and it is probable that as far as possible, torpedo-plane attacks will be made in the morning or evening dusk, on moonlight nights, or when the enemy is covered with a shallow and low lying fog above which the planes would operate In such fogs the plane has the advantage over the ship, that the visibility is better from above than from below and under conditions where the anti air craft gunner cannot see the plane it is possible for the pilot to see the broad outline of the ship While these conditions are favorable to the bomber, it is not likely that the torpedo plane will be able to do much in foggy or misty weather—this for the reason that the plane, during its approach must get a reliable bearing on the ship before dropping its torpedo

Both the British and our own Navies have carried out extensive practice in this comparatively new field of warfare Excellent results have been secured by both navies, and much attention is being given to the question of the tactics of torpedo-plane attack

Weather Bureau Record

FURNISHING of official weather data in admiralty proceedings is one of the important phases of the marine meterological work of the Weather Bureau The records of the bureau form practically the only source of such information In some cases applicants for information will tell the bureau what they are trying to prove in others this is not known For the most part inquiries relate to storms and resulting damage to cargo or delay in shipment A few are in regard to missing ships

Ferry Boats with Turbo-Electric Drive

THE wide range of speed control which is such a marked feature of the turbo-electric drive assured its extended application in Marine practice once it had been fully developed One of the earliest and most notable installations was that made in the collier "Jupiter" of the United States Navy in 1912 This vessel and her sister the "Neptune" were both about 20,000-tons displacement and were designed to be driven at 15 knots by turbines of 7000 horsepower The "Neptune" was provided with a mechanical reduction gear between the turbine and propeller shaft, and in the "Jupiter" was installed the new electric system of reduction It was this comparison and the success obtained with the "Jupiter" which led to the wide adoption of the turbo-electric drive in our Navy all of our latest battleships being equipped with this system Then followed its introduction into the merchant service, and of late years it has found increasing favor among yachtsmen and especially as an auxiliary drive for two and three-masted schooners

And now comes a further application in the equipment of two new ferry boats the Hayward and the San Leandro which are operating on the ferry boat service across San Francisco Bay between San Francisco and Oakland It had been apparent to the Board of Directors that during the hours of peak load travel the capacity of the existing ferry boats, which are among the largest of their kind in the world had been reached and the necessity for more and larger ferry boats was realized After an exhaustive study of the various types of propelling machinery it was decided that the turbo-electric system was the most appropriate for this very exacting service The new type of vessel which we herewith illustrate was designed by Mr John B Matthews Naval Architect of San Francisco assisted in matters pertaining to the selection of machinery its installation and so forth by Captain J F Dorry of the United States Coast Guard Service

This is one of two turbo electric-driven ferry boats, recently built for the Oakland San Francisco service Length, 240 feet Speed, 13 15 knots

The boats which are built of steel are 240 feet in length 42 feet in molded breadth 62 feet 6 inches in breadth over the guards and they have a molded depth of 19 feet 6 inches The hulls are designed to insure absolute stability and great steadiness in the somewhat rough weather which is at times encountered on San Francisco Bay and the weight of the framing and plating is somewhat in excess of that usually required by the American Bureau of Shipping There are seven water tight transverse bulkheads, so spaced that any one compartment may be completely flooded without endangering the safety of the vessel The contract speed of the boats was 13 knots and the main propelling machinery built by the General Electric Company consists of one turbo-generating set of the impulse marine condensing type with a normal rating of 1000 kilowatts, 500 volt direct current with one 75 kilowatt direct connected, 115-volt exciter

The turbines operate on 210 pounds steam throttle pressure with 50 degrees superheat and a vacuum of 28½ on a 30 inch barometer reading Steam is supplied by two Babcock & Wilcox boilers carrying a steam pressure of 225 pounds a square inch They are fitted with super heaters capable of furnishing steam at 65 degrees Fahrenheit above normal The boilers which are of the oil burning type are fitted with Coen type burners under natural draft.

The vessel is fitted with two General Electric motors of double armature type each designed for 1200 shaft horsepower at 125 revolutions a minute, and each is coupled through shafting to its own propeller independently of the other It will be understood of course that the ship carries a propeller at each end The outfit is so arranged that either motor and its propeller may be operated to full speed requirements and only with a slight dependence upon the other motor This is effected by the Ward Leonard system of control which is operated from the engine room This control is such, that when the motive power is furnishing all the driving power of the boat through the rear propeller, the speed of the forward motor can be regulated so that it will revolve only rapidly enough to relieve the drag or resistance of the forward or idling propeller and vice versa when the direction of the vessel is reversed.

Now this arrangement of the driving machinery is a complete departure from previous ferry boat practice It eliminates the vibrations caused by the resistance of the forward propellers which occurs in ferries operated by reciprocating steam engines which have a continuous shaft throughout the length of the vessel with propeller wheels at each end operating at the same speed The total passenger carrying capacity of each of the new boats is 3000 with seating capacity for 2000

The generator and exciter of the turbo-electric drive

A severe test of the seaworthiness of these boats was obtained on the trip north of the Hayward on the Pacific Ocean from San Pedro to San Francisco Bay when the vessel was navigated through heavy rain squalls in a very rough sea The boat showed her stability by righting herself in the heavy seas in a very easy and prompt manner In the tests for acceptance the Hayward reached a speed of 15 knots or 17 20 land miles per hour and during the special tests to determine the maneuvering qualities of the boat it was found that when the motor control was thrown from full speed ahead to full speed astern the motors actually started to revolve in the reverse direction in 2 2/5 seconds and that the time required to bring the vessel to a dead stop under normal conditions was only 30 seconds Tests showed that the idling motors automatically took 31 per cent of the load in starting and stopping and that this gradually diminishes to merely a friction load as the boat comes up to speed

Coal and Coal Tar

It takes a million years for a lump of coal to form but only a few minutes for it to be burnt up and totally destroyed. To the average man the sole use for coal is to heat his furnace so that he can keep warm in cold weather. In times of stress, as during the past winter, the fact that coal is very necessary for this purpose is brought home to him emphatically by simply having to do without it for a short time. Of course, it may be known that coal has other uses than the mere production of heat and power but it is hardly appreciated by the average citizen that a great many of the comforts and necessities of life without which he could hardly conceive of living, are available to him just because Nature, millions of years in the past started a process of decomposition of vegetable matter under suitable conditions of pressure and temperature, which resulted in the formation of the product that we call coal.

When the shovelful of coal is thrown on the fire there is little thought that enormous potentialities are being consumed in smoke. If the flames could reveal their story, there would be unfolded a picture, far more wondrous than the most impossible fairy tale. For in them there would be seen the hospital and sick room with the doctor or nurse administering a life-saving drug made from coal, the battlefield with shot and shell bursting all around, exploded by products derived from the same source, the fertile fields, sown with grain, corn and other life-sustaining plants, bearing abundant crops of foodstuffs, fertilized and rendered productive with products derived from coal, the fair lady's boudoir with the fine cosmetics and exquisite scent bottles, owing their fragrant odors to perfumes made synthetically from products obtained from coal, the counter in the department store strewn with fabrics colored in most variegated and splendid colors, the Tyrian purple once the color par excellence of royalty and the mighty of the earth, now rendered available to everyone no matter what his station in life may be, through the synthetic dye, even more beautiful than the natural product that dye manufactured from coal derivatives. This picture would cover practically every field of human endeavor, every daily necessity or luxury, for coal, coal tar, ammonia, the hundreds of derivatives that are produced from the parent substance, coal, enter into the manufacture and the production of most of the materials and articles, met with in every day life. The burning of a lump of coal in the furnace or stove represents not merely a consumption of carbon to produce heat or power, but the destruction of an immensity of possibilities, such as is not equalled by any other single action of common every day occurrence.

One of the principal uses of coal is in the manufacture of gas. There are different kinds of gas, according to the use to which it is put. Thus, the ordinary gas that we burn in our gas ranges or perhaps use for lighting purposes as well, is coal gas or illuminating gas. Coal gas is made by baking the coal in specially built ovens. The coal is not burnt as many people suppose, but it is baked or destructively distilled. Water gas is another gas which is used in the household either as such or in admixture with coal gas. Water gas is made by blowing steam through a hot bed of coke, heated to incandescence. This gas, while suitable for heating purposes must be enriched with the gaseous products obtained by dropping gas oil, a petroleum product, on heated plates, so as to make it usable for illuminating purposes. Another gas, made from coal or coke is known as producer gas, which is used exclusively in the factory for manufacturing purposes.

The gas industry, that is the coal gas industry, started in England. In 1792 a man named Murdock first employed coal gas lighting purposes on a large scale. From then on the progress of the industry was rapid until today there are over 1500 gas companies in this country alone. Now, in making gas from coal, it was soon found that there were many substances mixed with the gas which were decidedly deleterious to its use in the household. These substances had to be removed from the coal gas, before the latter could be used safely and conveniently for cooking and lighting purposes. The task of scrubbing and absorbing these impurities ammonia, sulfur, tar, cyanogen was first considered a troublesome and costly affair, until it was found that the value of these products and of the various manufactured substances that could be obtained from them was far in excess of the value of the gas itself. Thus ammonia was converted into the valuable fertilizer sulfate of ammonia, or into the explosive nitrate of ammonia. The sulfur and cyanogen were changed into various iron derivatives, which are useful as pigments for paint and varnish manufacture or in making other pigments.

Of all these substances, the coal tar looked perhaps the least promising but contained the greatest potentialities of all. For a long time the tar was looked upon as a good deal of a nuisance and there did not appear to be any way of using it. All sorts of efforts were made to get rid of the messy substance and surreptitious dumping was resorted to in certain cases. The continuous production of this substance, however led to considerable investigation to determine its exact composition and the possibility of obtaining useful products from it. It was soon found that it contained quite a variety of constituents and that it was in reality an extraordinarily complex substance.

While this development was going on in the gas industry and uses were being gradually discovered for gas works tar, another large growth took place in the steel industry and in the manufacture of coke, which are essential correlated industries. Coke is the residue that is left when coal is destructively distilled. The first process of making coke for the blast furnace was to burn the coal in covered piles, avoiding the presence of an excess of air. The same valuable by-products that are obtained in gas manufacture were allowed to go to waste, until the by-product coke oven was developed. The use of this oven allowed the recovery of the by-products, particularly coal tar, which is derived from this source in greatest amount at the present time. To the ordinary person tar is tar, but there really is a great difference between the various kinds of tar recovered in the various processes of distilling coal. Furthermore each and every tar has its special applications.

There are very few uses for the crude coal tar. It is mixed with creosote oil and employed for the impregnation of wood paving blocks to waterproof and preserve the same. Besides its use as a fuel in the plants where it is produced, this is practically the only important, commercial use for crude coal tar, although the purified and dehydrated crude coal tar is employed for the impregnation of felts in the manufacture of roofings.

But, when the constituents of the coal tar are separated from it, then there are obtained substances which are perhaps among the most important chemicals used at the present time and which form the basis of the manufacture of a greater variety of products than any other raw materials known to the industrial world. The coal tar is distilled, yielding the following products: light oil, carbolic oil, dead or creosote oil, anthracene oil and the residue pitch. By further distillation of these products there are obtained benzene, toluene, xylene, pure naphthalene, pure anthracene, pure phenol and cresol. These substances form the basis of the synthetic dye industry and are also utilized in the manufacture of synthetic perfumes and drugs. The drawing on page 378 will give an idea of their scope and industrial importance.

Benzene is a clear colorless liquid, possessing a distinct odor and entirely different from the benzine distilled from petroleum. It is used as a solvent for paints and varnishes, in the dry cleaning of clothes, for extracting fats and greases, in making rubber cements and as a fuel for automobile engines. From benzene it is possible to synthesize aniline, which is the basis of a large class of synthetic colors, known as aniline dyes. Synthetic phenol is made from benzene, and the former may then be converted to the military explosive, picric acid and various other substances used in building up the most complex dyes, drugs and perfumes.

Toluene is the basis of the explosive TNT, which was

(Continued on page 435)

Color in Nature

We live in a world of color. Not only is color a natural characteristic of all forms of nature but Man endeavors to surround himself with even more color by dyeing his textiles, painting his houses and structures and in fact coloring almost everything that he fabricates not excepting his own person. He finds a principal use for color as a decoration although during the past war, emulating the example of nature he employed colors in camouflaging his ships on the high seas, his structures and gun carriages on land to protect them by rendering them less visible to the enemy.

Color in nature has its utilitarian purpose as well as its decorative. The coloring on animals affords them protection by causing them to blend with their surroundings so that their natural enemies and Man cannot easily find them. The green coloring matter in leaves is a chemical reagent and converts the carbonic acid gas taken into the plant from the air into starch and cellulose and the complex substances found in plants. The beautiful coloration of flowers serves to attract to them the pollen bearing insects. The yellow stripes of color on the skin of the tiger, the sandy skin of the lion, the spots of the leopard, the stripes of the zebra, the white fur of the polar animals, the dull coloration on fishes, the brown color of insects are all examples of protective coloration. On the other hand the brilliant colors of the feathers of birds are for decorative effect only and play a part in sexual attraction.

The average person is apt to think that all the color effects that are seen in nature are produced by the presence of certain substances, dyes or the like, which possess distinctive colors. This is true to a certain extent as it has been found that the colors in flowers are due to the presence of substances known as anthocyan pigments. But the dispersion of light in striking scales and other agencies such as minute air cells is sometimes the cause of the colors that are seen in birds' feathers. Thus the feathers of the blue bird, the king fisher and other birds are colored blue due to the dispersion of the light striking the minute air cells in the horny structure of the feathers. So far no blue pigment has been extracted from these feathers.

Similarly the brilliant iridescent colors in the tail feathers of the peacock or in the throat feathers of the humming bird are not due to the presence of any pigments in the feathers, but to the dispersion of light by the thin laminae in the barbules of the feathers. This conclusion is substantiated by the fact that when the feather of the peacock is viewed in transmitted light it shows none of the color effects that are seen when the light is reflected and refracted from the surface of the same, and furthermore different color effects can be seen by having the light strike the feathers at different angles. On the other hand certain bird feathers also possess color pigments which either determine the color of the feathers alone or serve as a background for the color effects produced by the action of light.

The blue of the sky and the blue of the human and animal eye are also caused by the action of light. In the first place the dust in the air causes the dispersion of the light and its decomposition into its component parts, while in the case of the eye it is due to the presence of finely divided particles suspended in the liquid medium of the iris. Green, brown and black eyes take their color from a combination of this light dispersion effect and the presence of actual color in the eye.

Flowers and fruits owe their color principally to the presence of pigments in them, although in the case of the lily, the white color is due to the structural make-up of the petals. Of course the number of different coloring matters in nature is very great, but probably the most interesting and most important of these substances are the anthocyans, which produce some of the most beautiful effects. It has been found that the color of the flower or the fruit depends not only on the presence of some of this series of coloring matters but also on the presence of certain other substances such as tannin or iron salts. Then again the color will vary according to whether the anthocyan is present in the fruit or flower either in the free or combined state.

A few examples are cited to show how the color effects vary in natural products with the presence of different anthocyans. Thus cyanin is responsible for the coloring of the cornflower although it is present only in the proportion of 0.7 per cent. But when it occurs in as high a proportion as 14 per cent it produces a dark red coloration as in the garden variety of this flower. Violanin is the coloring matter in the violet pansy in which about 33 per cent of the substance is present. Asterin and chrysanthemin are the coloring agents which we find in the aster and the chrysanthemum respectively.

It is strange that these coloring matters, which give such lasting colors in flowers produce only fugitive results when used on textile fabrics. They are all complex substances and one of the real marvels of nature is the ease with which the plant builds up these coloring matters. The chemist succeeds in synthetizing them with great difficulty only, and by methods so complex that it is obvious that we are not even on the road toward learning how the plants do it.

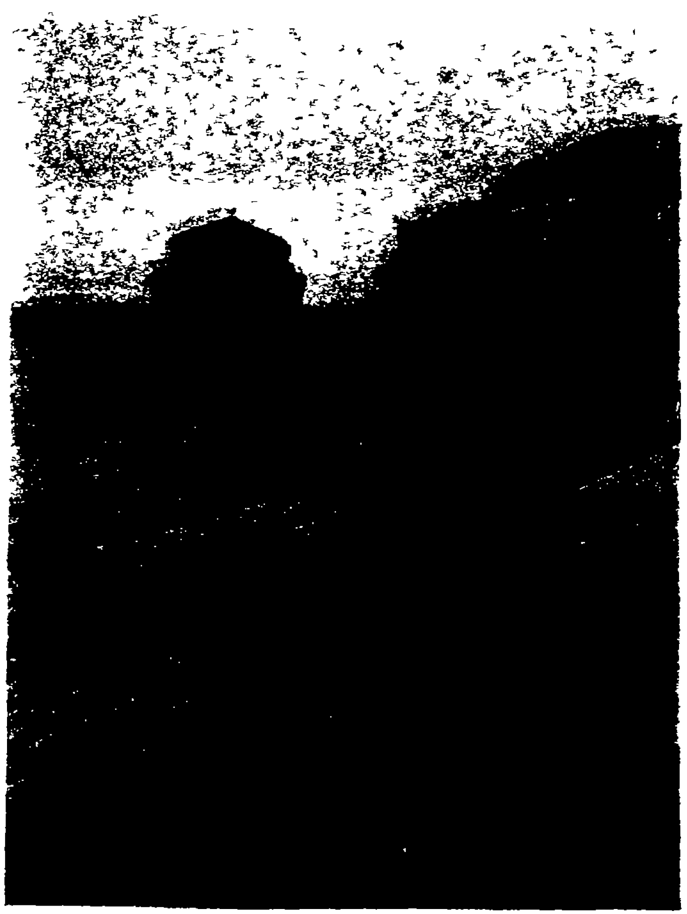
No, this is not Hell Gate bridge. It is the accepted design, modelled on that famous structure, for Sydney Harbor bridge, Australia. Its length, 1650 feet, will render it the largest arch in existence

AMONG the natural harbors of the world that at Sydney, New South Wales, Australia, holds a commanding position. Landlocked, and approached by a single and extremely picturesque entrance, the harbor broadens out among the surrounding hills and represents, not only abundant anchorage but a long stretch of shore line suitable for docks and terminal facilities. Sydney harbor however labors under the same disadvantage as the port of New York to the extent that the city is divided by a deep and wide waterway which cuts it in half. In this respect the channel between Dawes Point and Milsons Point is as much an obstruction to free intercourse between various points of Sydney as the Hudson and East Rivers are between Manhattan, Long Island and Jersey City. Hitherto transportation at Sydney has had to content itself with the lighter and the passenger ferry boat, and in Sydney as in New York the problem of rapid transit across the waterway for many years has been the subject of much deliberation and planning.

In the SCIENTIFIC AMERICAN of September, 1922, we published a drawing showing the proposed plans for a large cantilever bridge designed by John J. C. Bradfield the chief engineer, for crossing the channel at Sydney. In the interim, further study of the problem has been made, and the chief engineer made an extended tour in the United States, England and the continent of Europe to study the existing long-span bridges of those countries. Upon his return, he enlarged the specifications for the Sydney bridge to include plans for bridging the channel with the great arch bridge which forms the subject of our illustrations. Tenders were asked from the engineers of the world and as a result no less than twenty two separate plans were turned in by six different firms. The designs were of a very wide variety of types and included six for an arch bridge two for a cantilever arch eight for a cantilever, five for a suspension and one for a cantilever suspension bridge. The successful bidder was the English firm of Dorman Long & Company which in addition to its manufacturing plants in England, for many years has owned extensive works in Australia. The bids were made upon the design drawn up by Mr. Bradfield as shown in the accompanying illustration. The total cost is about twenty-one million dollars, and the total weight of steel in the bridge will be 50,626 tons.

Among the bids was that of the McClintic Marshall Products Company of Pittsburgh, who put in one bid for an arch bridge, three bids for a cantilever and one bid for a suspension bridge. Of these designs the suspension bridge designed by Mr. Gustav Lindenthal was the lightest, and called for a total of 43,059 tons of steel.

It should be mentioned that the terms of the specifications, as laid down by the New South Wales authorities, called for the construction of a part of the steel work in Australia the balance, including the heavier rolled members, to be imported from abroad, if so desired, should the successful bidder be a foreign firm. The tariff upon the imported steel, coupled with the high cost of American labor and the cost of transportation, placed a heavy handicap upon any United States competitor. The successful bidder, however is in the advantageous position of possessing long-established works in Australia, which they intend to enlarge, building new mills, which will enable



A portal of the great arch bridge across Sydney Harbor Channel, Australia

them to fabricate the bridge work in Australia and near the site.

The new bridge is favored as to its site by the fact that on each shore good rock suitable to take the heavy thrust of the abutments is found not far below the surface. Sydney Harbor and Sydney are renowned for their picturesque beauty, and hence the question of esthetics carried considerable weight in determining the type of bridge. It was felt that an arch bridge, better than any other type, would harmonize with the surroundings, both because of its artistic and its monumental effects, a decision with which we are in hearty agreement.

On each shore the bridge will terminate in a massive tower, faced with cut granite which will be of solid construction up to the floor of the bridge and above the floor will consist of two individual towers. The length of the bridge between the end pins will be 1650 feet or 50 feet longer than the Brooklyn bridge in New York. The width of the floor will be about 100 feet. The great arch will be 180 feet deep at each portal and 60 feet deep at the crown of the arch. The clearance above water will be 170 feet and the crown of the arch at its center will be about 400 feet above the water.

The floor system will be built up of the usual floor beams and stringers, covered with steel buckle-plate upon which will be a layer of concrete finished off with a water tight asphalt surface. Provision will be made for four railroad tracks, two for the main line service and two for trolley service. There will also be a center roadway 57 feet wide and two 10-foot pathways for foot passengers. The steam railroad tracks upon which the design will be based, are designed to carry a load of two 130-ton locomotives, each 65 feet long, followed by the usual train load, and the trolley track load will consist of the heaviest modern electric cars.

Now to American eyes and especially to New Yorkers, this design for the Sydney bridge will look strangely familiar. As a matter of fact the design is based upon Mr. Lindenthal's famous Hell Gate bridge, and so far as the skeleton outline is concerned, it is practically a 50 per cent enlargement of that design. The similarity is observable even to the reversed curve of the upper chord of the bridge at the portal, which was used for the first time in the Hell Gate bridge, and was put in to obtain the necessary clearness for the traffic. Also, the system of triangulation in the arch is the same and Mr. Bradfield chose also an odd number of panels, with counters in the central panel all characteristic features in the Hell Gate design. If imitation is the sincerest flattery as the old adage says, American bridge engineers should be gratified that in building this, the greatest steel arch in the world, its engineer should have come to America for his inspiration, and this in spite of the fact that nowhere in the specifications has the slightest credit been given to the designer of the Hell Gate bridge.

It is of interest to note that for its size, the Hell Gate arch is the heaviest in existence and will continue to be so when the Sydney structure has been completed. The live load of the latter is 12,000 pounds per foot, whereas the Hell Gate live load is 24,000 pounds, this being due to the heavy test loading for Hell Gate of four continuous lines of the heaviest steam locomotives on each of the four tracks.

Fighting the Bed Bug

How a Bitter and Dangerous Enemy of Mankind Is Being Routed With Such Weapons as Propaganda and Poison Gas

By James H. Collins

The Modern Pied Piper of Hamlin—bed bugs and all vermin are now exterminated with poison gas, applied by a masked operative

IN HIMSELF the rat has no commercial value. Man has seldom been forced to eat him, and his pelt is worth little or nothing. Therefore man has lived tolerantly with the rat for ages, reducing the rodent population from time to time when damage to and destruction to his goods grew beyond the point of tolerance. But the fight was never carried to extermination—in fact, until this generation man has not had scientific means for exterminating the rat.

This will undoubtedly strike you as a novel way of looking at Brother Rat. It is the viewpoint of an expert who has made a life study of rodents and other vermin, Mr. N. N. Sameth, executive head of a large New York exterminating organization, who attacks man's pests with the weapons of the bacteriologist, chemist, biologist and entomologist, and who has lectured on the subject to the public health service classes at Bellevue Hospital and other institutions.

Today, a new weapon is being turned against the rat—public opinion. The discovery that he transmits through his fleas such terrible diseases as bubonic plague and typhus has made an appeal to the man in the street, enlisting him in a world war of extermination.

Hand apparatus for exterminating insect pests in small rooms

This war has only reached the skirmish stage. Even in a city like New York, where the health authorities systematically trap and examine thousands of rats yearly to guard against plague, the rat population is on the increase, and newspaper accounts of persons being attacked and bitten by rats in their homes—particularly children—are becoming more frequent. Mr. Sameth says that they will be even commoner news until it is made unlawful to harbor rats, because Manhattan Island, bounded almost wholly by water, prevents emigration of increased rodent population, and where one property owner takes steps to rid his premises of rodents, ten others harbor them.

Just as scientists mobilized public opinion by 'getting something' on the rat, now they are working to 'get something' on a more widely annoying pest—the bed bug.

Tell the man in the street Pattos has demonstrated that the bed bug's bite transmits the parasite of the tropical disease known as kala azar, that Nuttal succeeded in transmitting germs through the bite of bed bugs from one mouse to another, that it is supposed bed bugs spread the germ of Obermeyer's relapsing fever, that Pasteur and Metchnikoff were probably the first to bring the bed bug under suspicion as a disease carrier——

'I should worry!' thinks the man in the street in New York, South Bend or Gopher Prairie. 'Probably" and far off tropical maladies that he never heard of do not give him the necessary thrill of fear. But if this pest transmits something right around the corner, like tuberculosis, and it can be proved, public opinion will condemn the bed bug and demand its extermination.

"Dutton has shown by experiments that the bed bug may spread typhoid fever," says Mr. Sameth. "Bugs were infected by feeding on the blood of a person in the acute stage of this fever, and the bacilli were retained by the bug in a virulent condition for at least twenty four hours. There is evidence that the bug assisted in the spread of the influenza epidemic, particularly in lodging houses, boarding houses, hotels and other places where the same beds are occupied by different persons in succession."

Until the war, bed bugs were a reproach to nice people. When they appeared, nice people got rid of them by greater cleanliness. But the war crowded humanity together everywhere, and as people crowd, pests of every kind increase. Today not even nice people escape the bed bug. He may turn up in the most carefully kept homes. His presence is not a reproach, but a danger signal.

The bed bug is a great traveler. Not content with a comfortable home in some cheap boarding house, he attaches himself to clothing and is carried to the locker room of an office, the cloak room of an hotel, the back seat of an automobile, the berth in a sleeping car. There he switches to some other person's clothing and invades an uninfected home. Maybe only one of him, and he is used correctly here, for in breeding sex doesn't matter at all in the travels of this pest. Both the female and male carry a supply of eggs ready to set up housekeeping and raise a family when they find suitable quarters. Six weeks is enough. Before the days of steam heated apartments, incubation was checked during the winter, but now it goes on practically all year round.

Back in prehistoric days, the little brown parasite was presumably a wood dweller and vegetarian. He had wings, of which remnants can be seen under the microscope. It is conjectured that when man came out of caves after the last ice age and began building log cabins, the insect was carried to the first houses with the logs. There he found a richer and more abundant kind of food than plant juices—human blood. He became lazy, lost his wings, and ultimately turned cannibal. He is still lazy, for once settled in walls and sleeping places he will not travel far from home by his own exertions. But he does get carried about in many ways.

"He is introduced into clean homes in ways which are unsuspected," says Mr. Sameth. "Packages are brought from infected places or by people who may be carriers. Such packages are often dropped or opened on beds or couches. A party brings an unusual number of guests, coat racks and hooks are filled with their wraps, and the bed is used for the rest. Laundry packages, clothes brought home after pressing, mattresses sent to the renovator, books from circulating libraries, baggage brought into the home by members of the family who have been traveling, moving vans and warehouses in which furniture is carried or stored—these are channels through which the insect constantly travels and may find entrance. Servants visit their own homes in infected tenements, bringing the pest back with them. Clothing hung in offices, factory lockers and even checked in hotels, restaurants, clubs and theaters is a common means of transportation. When his methods of traveling are known, a little care in receiving packages, hanging up outer clothing and not using beds as catch alls, is good prevention, and will keep him out nine times in ten. But sooner or later he is pretty certain to arrive."

Apparatus for generating and applying hydrocyanic gas in bed bug extermination. In New York it costs $5 to $10 a room, and requires about three hours

The vitality of this insect is remarkable. Specimens hatched in the laboratory have survived several months without tasting food from birth to death, while others fed in the laboratory have lived from two months to a year. A solitary specimen brought into an empty apartment will rear a family and thrive, though people may not enter the room for months. If its principal food is lacking, it will drop down to a mouse or rat hole and feed, or suck blood from a cat, a dog, a bird. If these recourses are lacking, individual insects may die after several months' starvation, but the colony goes on a year or more. It was once thought that the insect could live on moisture from wood or the dust found in walls and floors. This has never been demonstrated, but entomologists believe that the colony can support itself for a long period by cannibalism, the old eating the eggs or the young, and the young living on insects that die of old age. Although the insect stops feeding and breeding when the thermometer goes below 60 degrees Fahrenheit, he will live through long periods through temperatures lower than freezing. In fact, he is far more troublesome in northern than southern climates, for he cannot stand heat nearly as well as cold. When the thermometer goes above 100, he dies.

For years, this pest has been fought with soap and

(*Continued on page 439*)

Clothed and unclothed views of the latest gasoline engine for stationary use

A Gasoline Engine That Is Different

BECAUSE of the similarity of most gasoline engines it is refreshing once in a while to see a gasoline engine that is decidedly different. And that is no doubt the reason why the Denison engine which is shown in the accompanying illustrations attracted unusual attention and a deal of comment at the recent National Good Roads Show held in Chicago.

The Denison engine is an inverted, two-cylinder four-cycle water cooled engine entirely housed in a pressed steel casing. The cylinders, bearing standards and base are all included in one casting, which makes the unit quite rigid and with permanent and proper alinement of piston, crank shaft and cam shaft. The crank shaft, cam shaft, magneto, governor assembly and the connecting rods are located on top of the main base casting so that adjustments can be quickly and easily made. The valve box which includes the valves, intake and exhaust manifold and the carbureter can be quickly and easily removed by taking out six machine bolts.

Cooling water from the radiator upon entering the cylinder block strikes the cylinder head which is the hottest part of the unit and rises as it is heated producing rapid water circulation and uniform cooling. Air is drawn through the radiator by a fly wheel type fan. The radiator is shrouded so that the dust and dirt going through it with the air does not come in contact with any part of the working mechanism. The fuel tank is located at the top of the housing. The new engine is on its face not adapted to automotive use but for stationary work of every description is claimed to possess many advantages over more familiar types.

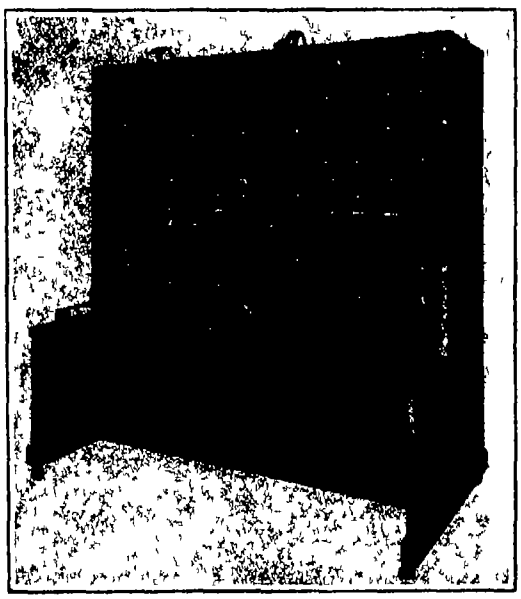
Electric Light Extremes

THE smallest and the largest incandescent lamps in the world, one rated at about one-quarter candlepower and the other at about 100,000 candlepower, make an interesting display when shown side by side. The large lamp, with a bulb 12 inches in diameter and 18½ inches high was developed primarily for motion-picture studio use. It is rated at 30,000 watts, or 1200 times larger than the average household lamp and the electric current required to operate three of these lamps would be equivalent to the power used to operate the average street car.

The small lamp, known as the "Grain of Wheat" is but a quarter inch in diameter and uses but one-fifth of a volt of electricity. It was designed for use in hospitals and by physicians. A lamp of this type was recently used by Dr. Chevalier Jackson of Philadelphia when he withdrew a tack from the lung of an eight months' old baby, Cletus Moore of St. Louis. The bulb is inserted at the end of a silver tube about the size of an ordinary lead pencil which in this case was inserted down the child's throat and gave enough light for the doctor to locate the tack.

The light from the big lamp is equal to the combined light from 2400 electric lamps of the size commonly used in the home. The filament is made of tungsten wire one tenth of an inch in diameter and 9 inches long, constructed into four coils. This wire if drawn into filament wire of the size used in the 25-watt household lamps would supply filaments for 55,000 such lamps. These lamps are classified as the Mazda C type being gas filled and are lighted from a 120-volt 250-ampere circuit. Consuming 30 kilowatts the cost to operate such a lamp with current at 10 cents per kilowatt would be $3 per hour.

Extremes of the day in electric lamps



The machine that reproduces, in miniature any short circuit of the high tension transmission lines whose effects it is desired to study

Foretelling the Effect of Short Circuits

WHEN the cord of an electric iron becomes worn, the two separate wires which carry the current touch each other. The result is a puff of smoke, a smell of rubber and no more heat in the iron. The electrician tells you that a short circuit has taken place and burned the wires in two.

This is a miniature of what happens when a power cable of an electric system breaks and comes in contact with another cable on the ground. Provision must be made to keep the damage as small as possible and to do so the electrical engineer must know what will be the effect of a large quantity of electricity running wild at any given point of a power system. As the calculations which give the answer to this difficult problem are frequently very complicated the General Electric engineers have devised a machine that tells in thirty seconds what would take that many hours to calculate by the slide rule and pencil method.

The machine weighs 3500 pounds and stands eight feet high. With its 104 adjusting dials it looks something like a combination of an overgrown radio outfit and telephone switchboard. In it are combined a great number of wires connected to what are known as variable resistance units which may be so joined that they will correspond to the network of cables of a great power system. Direct current is fed into this miniature power system at points where the great generators really would be in the actual system. The dials are manipulated to simulate the conditions which occur when any short circuit takes place, such as caused by a cable falling across a street car line or the breaking of a main feeder cable. As each accident is brought about in miniature the effect of the runaway current is told instantly by the sensitive needle of an electric meter.

When the Hammer Landed

WHAT happened when a ten-inch vacuum globe of glass was struck with a heavy hammer is told by the strip of pictures at the right of the page. The time consumed in the actual breaking of the glass as shown by the first five panels of the film is estimated at 1/500 second. The experiment was filmed with two cameras operating simultaneously, one at the standard speed of 16 panels per second while the second, an ultra speed camera was apparently working well in excess of 500 exposures per second. The standard camera shows the globe intact in one exposure and in the next frame it has disappeared completely with the exception of a few minute fragments. The ultra speed negative shows five stages in the breaking process followed by four views of flying fragments. The first film actually shows the slight indentation made in the glass by the hammer head; the second indicates that the first actual fracture occurred not at this point of contact but on the far side. The third view confirms this and shows that the breakage of the glass actually proceeds toward the point of impact from the point of initial fracture. The fourth and fifth views merely complete the picture.

Rapid motion analysis of the sequence of events in the breaking of a vacuum tube by a hammer blow

Cutting up sponges to make the miniature forests and orchards on the world's largest map

The Largest Map in the World

A Monster Model, in Relief, of the Entire State of California

By H. H. Dunn

MODELED of magnesite showing all the natural as well as man made features of an entire state the largest map in the world, is being erected in the state-owned Ferry Building in San Francisco by the combined efforts and funds of the 58 counties of California The map, which is about two-thirds completed, is 600 feet long and 18 feet wide, literally a "working model" of the entire State of California, costing $100,000 Its construction has required the constant work of J T Edwards, F R. G S, and 25 assistants rather more than a year, and it will be completed late in 1924 The cover painting for this issue shows a stage in the work on this giant map.

The map is in reality a huge model, but so fitted with interior and flood lights, all concealed, that one appears to be getting a perspective from an airplane or balloon of the whole state First of all, the state was built up in relief, as it was before white men came All the mountains and ranges were put in according to scale, all the rivers bays, lakes and coast line modeled on data furnished by the United States Geodetic and Geological surveys and the various departments of the State government. Then the mountains were colored according to the reports of these surveys, existing volcanic craters were formed, and the one active cone, Mount Lassen, equipped with internal lighting so as to maintain the effect of fire within the crater

Then the lowlands running from the foothills down to the sea, were put in with the Coast and Geodetic Survey furnishing the information as to coast line, bays, islands channels, and depths of water Cliffs, marshes, and sandy beaches were reproduced all in exact colors along the shore Forests of redwood oak and pine were made from carved fragments of sponges, painted green of the varying natural shades and set up at the proper locations and correct elevations in the mountains and hills Paved and unpaved roads grades for railroads, and all the mountain trails were then carved out as trenches and filled in with magnesite, white-surfaced for the paved roads gray for the graveled roads, and graded up with sand for the railroad rights of way Highways average about an inch in width, roads three-quarters of an inch and railroads half an inch Every mile of the 6000 of paved highways is shown in clear white finish and no railroad is too small to be shown Ties and rails were modeled and laid on the rights of way tunnels were cut through the mountain walls wherever they exist and trestles and bridges put in Every flag station on the railroads is shown by a tiny building, just as clearly as the large stations in the cities Mine shafts were bored and small buildings set up about them to show the productive mines, and the oil fields are located at the points on the big map where they belong, by miniature forests of tiny derricks.

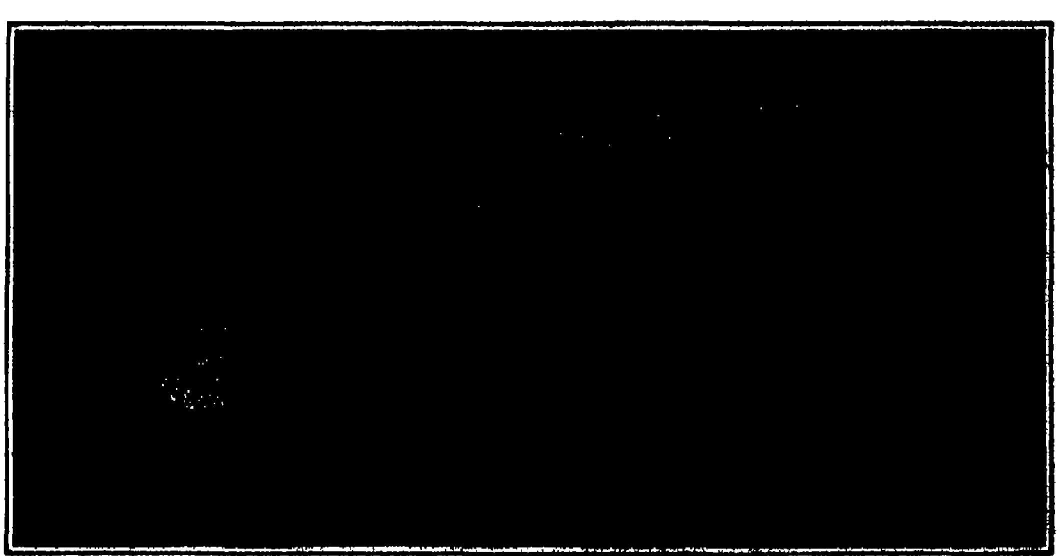
The cattle, sheep and horse-raising industries are indicated as to area by groups of these animals each half an inch in length, while the sections in which deer, bear, mountain lion and other animals exist are shown by similar models of these animals The grain section is shown by golden and brown sections of ripening grain the deciduous fruit districts by green groves of cherries peaches and apricots, and the citrus fruit range by similar groves bearing tiny golden balls indicative of oranges, grapefruit and lemons. No one of the trees is more than an inch in height, yet the effect is startlingly like that of looking at a huge photograph of a grove These trees and other features are, of course, out of scale with the length and breadth of the map but the answer to that is 'perspective'

Steamers and barges are placed on the rivers at the proper points to indicate directions and limits of inland water traffic, with small boats and rafts further up to show the extent of shallow draft boating Irrigation systems and hydro-electric power plants were put in Each city is indicated by a group of tiny buildings modeled after the structures in that city wharves are shown in the ports models of ships indicate the channels in each harbor, and the sea traffic lanes into and out of every port Locations are very accurately established, and the buildings in the center of each city are actually recognizable so carefully have they been modeled Blue lakes and reservoirs, and colored areas help to show the exact extent of irrigation, and where each irrigation system is located Every department of the State government and many of the departments of the national government contributed to this huge sculpture of the State

Tracing to scale, from a small map on to the baseboards for the big one, the outlines of San Francisco city and the adjoining rivers and bay

The Rotary System of Oil-Well Drilling

ON December 11, Mr L. R. McCollum presented to the Institution of Petroleum Technologists (British) an account of the rotary system of drilling, now of increasing importance throughout the principal oil fields of the world. Broadly speaking, two systems of drilling are employed today—the cable-tool or percussion system, whereby the hole is literally pounded out by a cutting bit alternately raised and lowered to produce a succession of "blows," and the rotary system in which a rigid pipe-stem rotates a special type of cutting bit, a mud-flush being pumped down under hydraulic pressure through the drill-pipe. This flush serves to lubricate the process of drilling, drive the cuttings up out of the hole, and at the same time 'mud up" the formations to prevent their caving, hence, the special adaptability of the system to unconsolidated and caving sands or silts such as are commonly met with in the Gulf Coast fields of Texas and Louisiana where the system was perfected in the first instance The cable-tool system is better suited to harder rocks. The chief advantage of the rotary system is the rapidity with which a well can be drilled, 450 feet per day being made under exceptionally good conditions, a far greater depth than is possible with the cable-tool in normal circumstances Further facts in favor of the system are that high gas and oil pressures are more easily controlled less casing is required for the lining of the well, it is less costly to employ than cable-tools, and it is more universally adaptable to conditions of modern oilfield development Two inherent disadvantages are the tendency through "mudding for the driller to miss oil shows, and the difficulty of obtaining uncontaminated samples for elucidating subsurface geological data The first depends for its solution on the efficiency of the driller The second has been lately successfully combated by the introduction and use of the core-barrel by which adequate sampling can be carried out. The rotary system finds its greatest exploitation in California and the Mid-Continent fields, and has materially contributed to the development of the field.



A fifteen-foot section of the map, finished and mounted to show the effect of the subdued interior lighting

A New Portable Microscope for Use in the Shop

THE examination of metals, particularly steel, under the microscope, has become one of the essentials in the metallurgical control of the steel and some other metal industries. It has heretofore been necessary, however, in order to examine metals under the microscope, to cut pieces from certain sections and submit them to microscopic examination in the laboratory. The object of such examination is, of course, to determine the size of the crystals and the condition of the metal after certain processes to which it has been subjected. It is also used for the detection of flaws, cracks, etc.

There has long been a demand for a microscope which could be used in the shop, that is, which could be efficiently employed to examine metal outside of the laboratory and without the destruction of the piece to be examined. For instance, there are often cases where it would be desirable to examine the surface of a crank shaft or an axle under the microscope but this has been impossible with apparatus heretofore constructed.

There has now been put on the market, however, what is known as a portable microscope. It has been developed by a firm in Jena, Germany, and is entirely different from the usual metallographic microscope employed only in a steel laboratory. It has been introduced in the American market. The illustrations give some idea of the construction of this new device. It is sufficiently rigid and easy to apply so that it may be given into the hands of the foremen of a shop for the inspection of work during any stage of finishing, or for making tests in connection with the heat treating department whereby valuable information about annealing periods, temperature for hardening, means for carbonizing, etc., may be obtained. It is also stated to be useful for settling difficulties with customers and suppliers of material. As our illustrations and text will make clear, the new microscope works directly upon the piece to be examined, without any preliminary sectioning, etching or other preparation.

One illustration shows the optical arrangement. The illuminating device (*a*) for day or artificial light reflects the light to the prism (*b*) from which by the aid of the objective (*c*) it is directed upon the specimen of metal (*d*). The other prism (*e*) directs light reflected particularly by (*d*) into the ocular (*f*). The microscope can be applied to shafts and other cylindrical pieces as shown by another illustration in which jaws are shown made in two sizes and so arranged that their distances can be varied by means of screws. If it is desired to examine under the microscope shoulders and billets in crank shafts, and other similar forms, this can be done in much the same way and with equal ease.

Undoubtedly such a portable microscope will find wide use in the steel and metal working industry because of its practicability and the fact that it can be used to examine many forms of steel without destroying the objects to be examined.

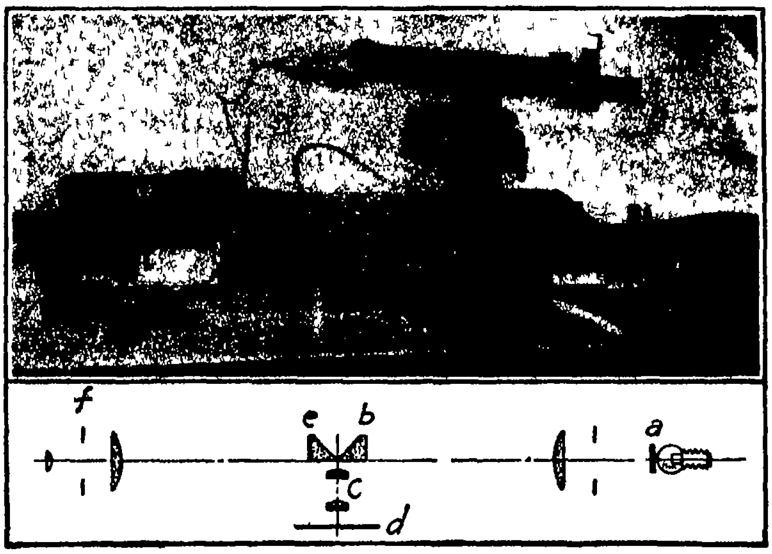
An Old Canal Put to Use

A DISUSED canal in Wales has been put to use to convey a pipe line to supply Cardiff with water. The canal is now used only by a few patent fuel and other factories which are conveniently served by railway. The use of the upper reaches of the canal for the pipe line saves enormous expense in trenching besides providing an easy route free from way-leaves. The acquisition of the remainder of the canal would greatly facilitate town development to the north of Cardiff, removing the necessity for many bridges, while it would provide a new thoroughfare through the heart of the city and permit the demolition of several very bothersome and dieback bridges.

Keeping Them Down to Eleven Tons

OREGON traffic officers are using a new type of scales to weigh trucks to see if their loads do not exceed the 22,000-pound limit set by the State laws. The scales, which are the first of their kind to be used in the West, are very handy. They are small and can be carried about by the traffic officers. When a heavily loaded truck is encountered the scales are placed in the street and the driver required to drive upon them. They are found a big help in enforcing the law against overloading, presenting obvious advantages over permanent scale installations whose locations would soon be known to potential violators of the law.

Roadside scales for enforcing Oregon's weight limits on loaded trucks



Above: General view of the entire apparatus. *Below:* The optical arrangements presented diagrammatically

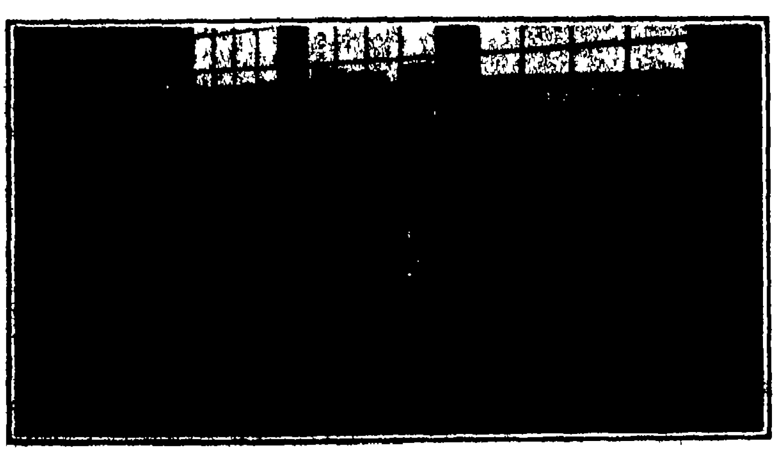
The microscope that can be taken into the shop and set up for use in a hurry, without special preparation of the specimens

Machine for Testing Airplane Ribs

IN order to test the ribs for airplanes, a special machine has been devised that has many distinct advantages. The most unique and valuable feature is the opportunity that is offered in the case of wooden ribs for changing the strength of the rib while it is being tested. For example, suppose that a rib is found to be considerably over strength, then the section of the diagonals, verticals or webs can be cut down while the rib is still in the machine. Thus the rib may practically be designed while it is under load.

The loads, which may be varied in amount, are applied by means of sliding shot cups mounted on graduated lever arms. The arrangement is such that the loads are moved simultaneously by means of a hand wheel located at one end of the machine. The load is applied to the rib by vertical rods provided with shoes at the ends where they come in contact with the rib. The length of the rods is adjustable to allow for the deflection of the test specimen. The direction of the loads is easily reversed as in the case of the nose load in a high speed condition by simply extending the lever arm on the other side of the machine. The arms are balanced at the start of the test by means of sliding lead counterweights. The effect of a uniform load is obtained as nearly as possible by accurate location of the loading arms and the use of distributing blocks under the shoes.

With this machine any type of rib may be tested, whether from wings, tail surfaces or control surfaces. As it is necessary to weigh out only one set of loads no matter how many factors are required, accuracy of weights is obtained and therefore efficiency. As the rib is easily accessible while in the machine, the failures are easily detected and due to the stops on the weight arms the rib is not completely destroyed after the initial failure.



Testing airplane ribs without destroying them

Stellar Evolution

TO KANT and to Laplace we owe the first rational hypothesis of stellar evolution, but they had at their command insufficient data to establish their nebular hypothesis on a sound basis. Within the last few years astronomers have accumulated a great mass of material which gives a more secure foundation for a consistent theory of stellar evolution. In the case of hundreds of stars much is known concerning their distances, their sizes, their densities and their temperatures. From the laws of physics we know the general trend of the changes which must take place in any star. If at first it is a highly rarefied and diffuse mass of vapor at a low temperature, gravitational forces will cause its gradual condensation, and this will produce an elevation of temperature, just as the air in an automobile tire becomes hot as it is compressed. As the temperature rises, the vapor will first become red hot and ultimately white hot. After the density reaches a certain stage, condensation will proceed more slowly. When the loss of heat by radiation exceeds that produced by compression the star will cool in reverse order from white to red heat. After it has contracted to the solid state, like the earth, the production of heat by condensation will cease, while cooling by radiation will continue, until the star loses its luminosity. Condensation and cooling will be extremely slow, and may be prolonged by internal development of heat due to superchemical transformations made possible by enormously high temperatures and pressures. These may cause the formation of one element from another by the aggregation of atoms. If such be the sequence of change in any star it is evident that it must pass through the red stage twice, the first time while rising in temperature toward the white state and again while cooling. It is an established fact that there are many huge dark nebulae which may be the original stuff of which stars are made and that the red stars can be separated into two well defined classes of giants and dwarfs, differing enormously in size and density but little in mass. These large differences in size are not found in the white stars which are all according to this hypothesis, in the same stage of development. What may be the final destiny of the dark bodies which are the final product we can only guess. Hundreds of thousands of such dead and invisible worlds must exist, most of them perhaps destined to wander through space for all time, but some of them may by collision with other bodies be again resolved into glowing vapor and begin a new cycle of existence.—*Abstract from article by Professor F. P. Lewis, in Science for November 23, 1923.*

The Story of Steel—VI

Open-Hearth Furnace, Making a Superior Steel, Supersedes the Bessemer Converter

IT WAS because the Bessemer converter rendered it possible to make steel with great rapidity and at low cost, that its inventor Henry Bessemer will always remain the outstanding figure in any history that may be written about the steel industry. To think of steel is to think of Bessemer.

In 1854, Henry Bessemer invented his Bessemer or pneumatic process in England and about the same time William Kelly of this country quite independently came out with a process of making steel also using a blast of air as the means. After considerable litigation a compromise was made, and today we know the pneumatic process by the name of Bessemer.

In 1861 Siemens developed his regenerative furnace, the underlying principle being as follows:

The hot gases are passed over the furnace body and thence through a series of checker brick and on to the stack. The direction of the flame is then reversed, the air being taken through these hot checkers absorbing heat and thus yielding a high temperature on uniting with the fuel. This continued reversal leads to a gradual increase in flame temperature which is today the basis of open hearth work. It was in 1864 that this important principle was developed by Martin and hence open hearth furnaces are called today Siemens-Martin furnaces.

The limitations of the Bessemer process did not hold for the open hearth, since it became possible to use materials of a greater variety. The process of refining is much slower, ordinarily from 6 to 12 hours, but it becomes possible to exercise a very close control of the reactions, make frequent tests of the metal in the bath and secure a steel of the exact composition required. So marked are these advantages that in the specifications for high-class construction such as bridge building where a very exact relation between the working stresses and the strength of the materials must be secured, there is an invariable call for open hearth steel.

The advantages of the open hearth process are summed up by those who are versed in the art as follows:

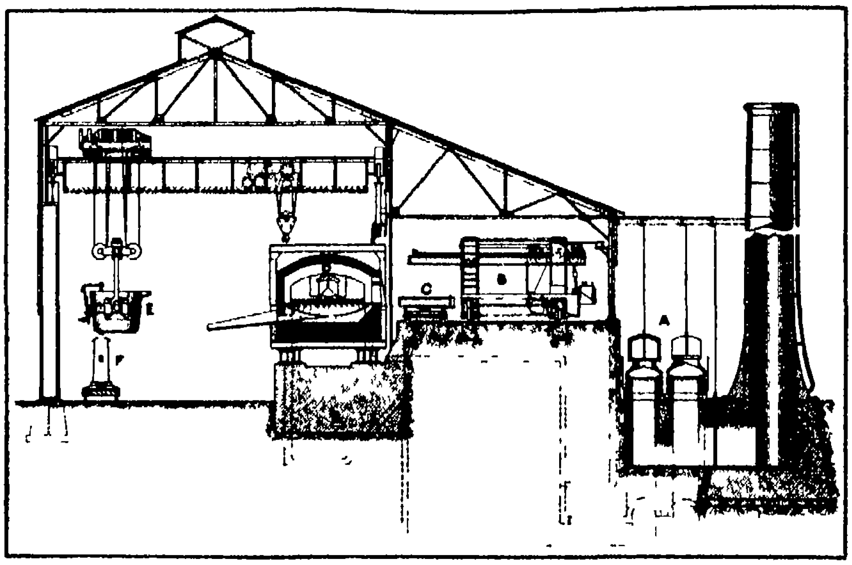
1. By the use of ore as an oxidizing agent and by the external application of heat the temperature of the bath, that is, of the materials in the furnace, is made independent of the purifying reactions and the elimination of the impurities (carbon, silicon, manganese, etc.) can be made to take place gradually, the temperature and composition of the bath being under much better control than in the Bessemer process.

2. For the same reason a greater variety of raw materials can be used and a greater range of products made.

3. A very important advantage is the increased output of finished steel which can be secured from a given amount of pig iron; hence fewer blast furnaces are required to produce the same tonnage of steel. This is explained by the fact that the Bessemer process uses all iron in molten form whereas the open hearth process can use iron in smaller proportion of the total charge, together with scrap.

4. With the development of the basic process it was found that the greatest advantage of the Siemens-Martin over the Bessemer was the elimination of phosphorus. While the basic Bessemer process requires pig iron with a phosphorus content of 2 per cent or more in order to maintain the temperature necessary for the reactions, the basic open hearth process permits the use of iron of less limited phosphorus content.

In 1908 the open hearth process surpassed the production of the Bessemer and today it may be said, roughly speaking, that the open hearth produces one hundred tons of steel for every twenty made by the Bessemer process. Natural gas which was formerly used in open hearth furnace work by its severe limitations in supply has been replaced as a fuel by producer gas, a product from the gasifying of coal in gas producers, by tar and by product gas fuel by products



To the extreme right is the stack. Then follow: *A*, air and gas reversing valves; *B*, charging machine; *C*, buggies, from which charger picks up boxes of "mixture," thrusts them into furnace *D* and empties them; *D*, furnace with charging door (right) and pouring spout (left); *E*, ladle cranes, with ladle *F* over mold *F* pouring an ingot

Sectional view, showing relative positions of parts of an open hearth plant

This shows the charging platform of a long line of open-hearth furnaces, with a ladle emptying its charge of hot metal into a furnace

in the coking of coal, and in later years by fuel oil.

The open hearth furnace, as shown in the illustration on the adjoining page, is a large rectangular structure, approximately 15 feet wide by 35 to 40 feet in length. At each end of the furnace are two large openings or ports, one to admit air and the other gas. The roof is of silica bricks, 3 inches by 9 inches by 18 inches deep. This highly refractory material is built in the form of a flat arch to give it strength and stability, and the whole furnace is held in place and tied together by heavy beams and tie-rods. The hearth or bottom of the furnace rests on steel plates which are carried by beams or channels resting on piers entirely independent of the rest of the structure.

In a basic furnace the bottom is made up of several courses of clay brick, upon which is placed a deep lining of magnesite, curved upwardly all around to form a trough like basin. This magnesite—a highly refractory material, is mixed with ground basic slag, and it is then set by slow heating and gradually brought up to a high working temperature thus fusing the bottom. The acid furnace is constructed in the same fashion, except that silica sand is used in place of grain magnesite. Furnaces today are practically all basic and range from a capacity as small as 5 to 15 tons for making special steels to as large as 125 tons. The average capacity today is from 60 to 75 tons per heat.

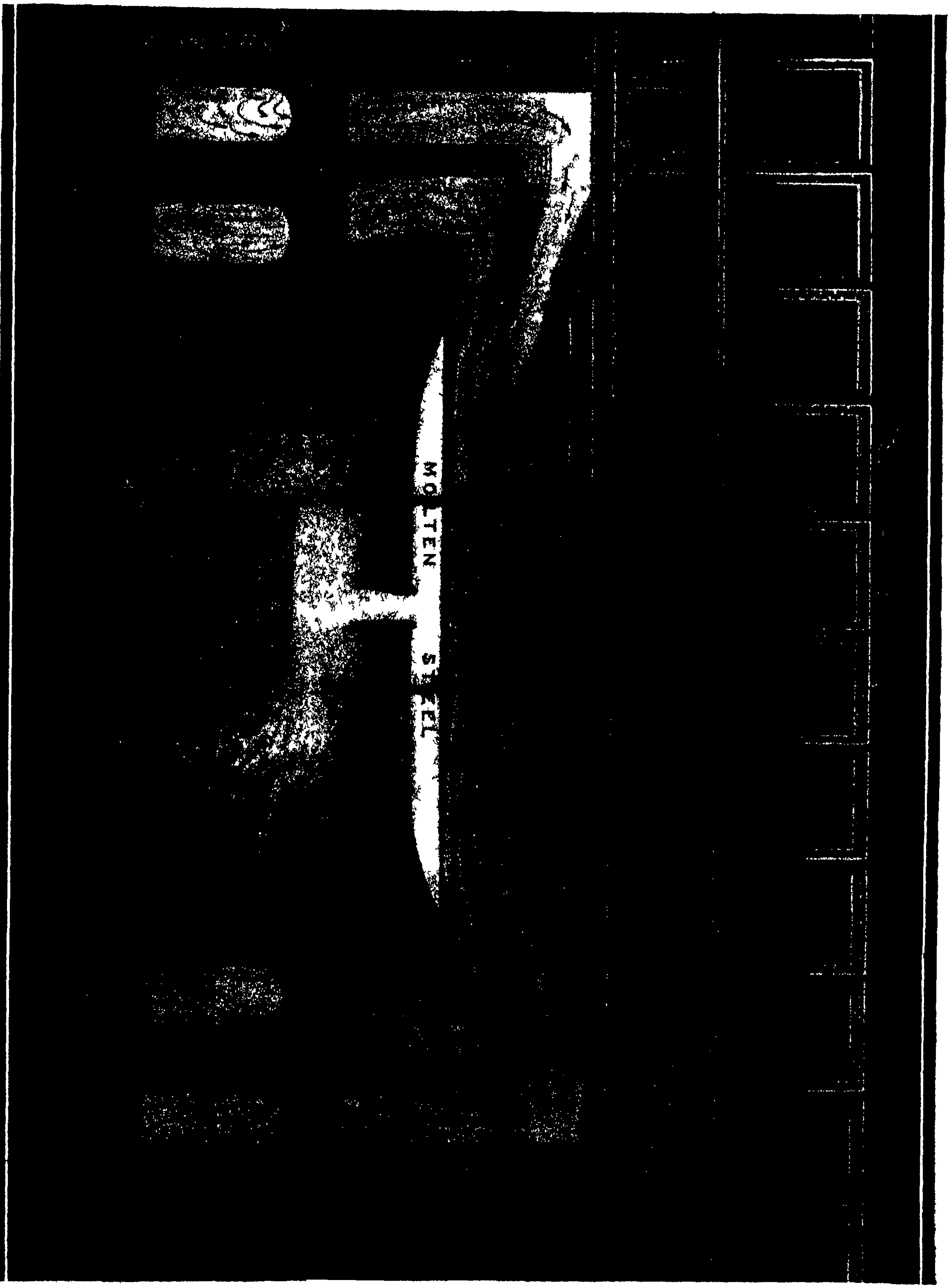
The open hearth process varies in different districts, depending upon the available pig iron and the scrap conditions. A typical plant in the Pittsburgh District charges a furnace as follows:

Raw materials, such as limestone, ore and scrap are assembled in a stock yard, in some cases the limestone and ore being in bins and dropped directly into charging boxes which are usually 20 inches wide, 20 inches deep and 6 feet in length. The various scrap is loaded into the boxes by magnets. All these materials are then assembled into a "heat" and a small engine pulls this load into the open hearth building, leaving it to be handled in the next step by the almost human charging machine. This machine has an arm which locks into the end of the charging box and can be pushed in towards the furnace and revolved. The door of the furnace is opened, the box is picked up and thrust into the furnace, the arm is revolved dropping the material on the hearth of the furnace, and the box withdrawn.

Limestone is placed on the basic bottom, then ore, then a certain amount of scrap, approximately 40 per cent of the total metallic charge. The charge is melted by burning fuel in the port end of the furnace in conjunction with the highly preheated air that has come through the checker work, as mentioned before, thus yielding a very high temperature of combustion. With the reversals in flame direction at intervals of 20 to 30 minutes, the charge is gradually melted down. This mass is heated until the scrap is white hot and slightly fused, then molten pig iron is added. This is taken from a mixer, which is a storage body for the hot iron coming from the blast furnaces, whereby uniformity in the quality of the iron is secured and a steady supply of hot iron for the open hearth furnaces maintained. The mixers are usually of from 300 to 1000 tons capacity.

With a scrap content of 40 per cent of the metallic charge, the molten iron would then be 60 per cent of the total when added. With the addition of this iron there occurs a lively reaction, during which almost all of the silica, manganese, phosphorus and part of the the carbon are oxidized or burned out by the oxygen, the first three forming compounds that slag with the iron oxide and join the iron and lime silicates which have already been melted. At the end of two or three hours about 80 per cent of this slag is drawn off. The ore acts on the carbon for three or four hours longer, the limestone being decomposed by the heat, and the carbon dioxide, bubbling up through the bath, exposes part of the metal to the flame, oxidizes it, and completes the purification

(Continued on page 439)

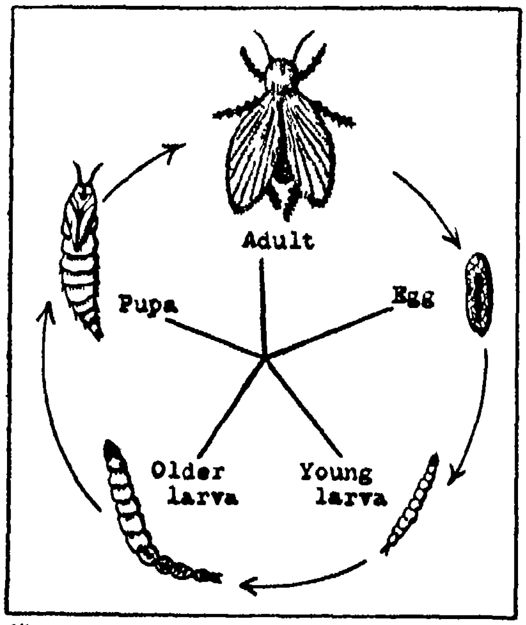


OPEN HEARTH FURNACE, SHOWING THE CHECKER WORK, GAS AND AIR FLUES, AND THE BATH IN WHICH 100 TONS OF METAL ARE REFINED TO STEEL. THE STEEL IS BEING TAPPED INTO A LADLE WHICH IS SUSPENDED FROM AN OVERHEAD TRAVELING CRANE

Birds and Sewage Disposal

An Interesting Relationship Involving the Relief of a Filtration-Plant Nuisance

By Leon Augustus Hausman, Ph.D.
Assistant Professor of Zoölogy, Rutgers College

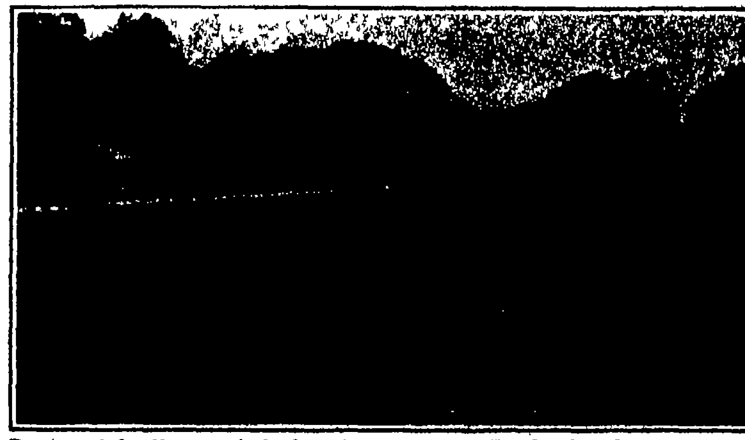


All stages occur in the filter film save the adult, and the birds feed on all stages except the egg (much enlarged over the other stages in this drawing)

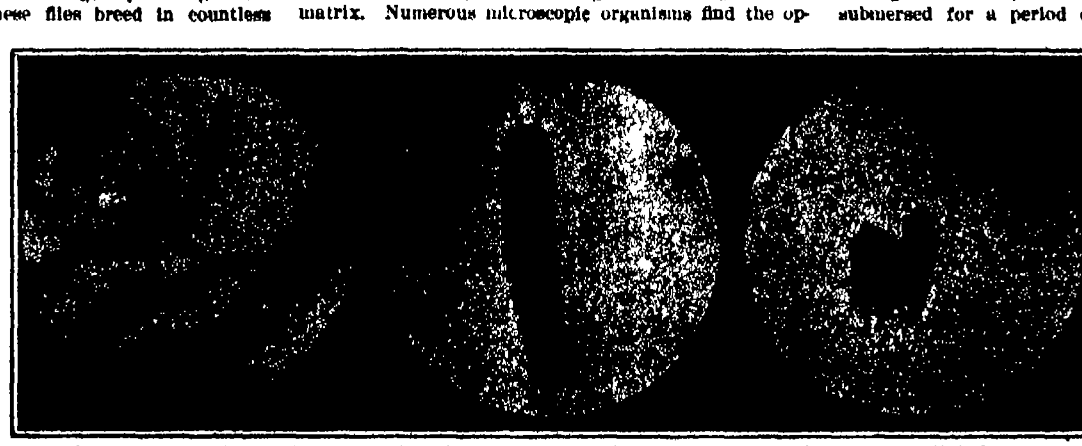
The life cycle of the sewage-filter fly

ONE of the most disagreeable features of a modern sewage disposal plant (in which a sprinkling filter is used for purifying the fecal sewage) is the presence of immense numbers of small, grayish, fuzzy flies, of the species known as *Psychoda alternata* and *Psychoda cinerea*, or sewage sprinkling filter flies (center views). These flies breed in countless numbers among the loose stones of the filter bed, and fly, or are carried by the wind, often to the distance of nearly a mile. Were their presence confined to the locality of the immediate neighborhood of the sewage disposal plant they would not be so great a pest, except to those working around such a plant, but they enter dwelling houses at considerable distances from the plant, and penetrating the finest screens make their way to all parts of the house, where they fall into the food and make themselves troublesome in many ways. They are regarded with disgust and fear—because of the character of their breeding grounds—and there exists a not unreasonable presumption that they are the carriers of infections and diseases. Nearly all sprinkling filters are breeding grounds for these pests.

In a disposal plant where the sprinkling filter is used the water from the incoming sewage is allowed to sediment out a portion of its suspended solid materials in large tanks, and is then sprayed out, by means of a multitude of nozzles, over a bed of stones, through which the water percolates and is purified, before it is allowed to drain off—usually into some neighboring brook. A typical sprinkling filter bed, with its sprays in operation, is shown herewith. Such a bed is about six feet in depth and is composed of irregular basaltic stones, of about the size of small hen's eggs, resting upon conduits which lead off the purified water. On the stones over the surface of the bed there usually flourishes a rich, greenish mat composed of *Oscillatoria* and other algae forms and on the under surface of these surface stones, and continuing to the bottom of the bed the stones are covered with a heavy, slimy accretion, made up of various fungi and water molds, with entangled bacteria growing in a gelatinous matrix. Numerous microscopic organisms find the optimum conditions for their growth in such a film and increase in numbers with the gradual growth of the film.



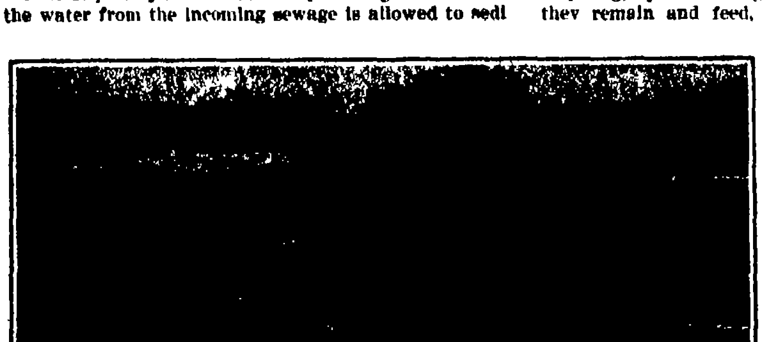
Portion of the filtration bed when the sprays are idle, showing the loose stones among which the Psychoda fly breeds



3: The larvae as they hatch from the egg, magnified about ten times. 4: The pupa or transformation stage, magnified about 18 times. 5: The adult fly magnified about 10 times

The sewage-filter fly in various stages of growth

It is in this film that the filter flies breed. The eggs are laid on the surface of the film, and the larvae, or young, upon hatching work their way into it. Here they remain and feed, and after their pupal change they emerge as adult flies. The film upon the stones collects, and grows in thickness during the winter and early spring, and with this growth there occurs an increasing number of flies. Hence in the early part of the season the pests reach their maximum numbers. A single square inch of stone may contain film enough to harbor from forty to seventy larvae. Even in midwinter it was found that a single stone from near the surface of the bed supported nearly a hundred larvae and pupae. Breeding in the film goes on from the top to the bottom of the bed, but is concentrated usually in a zone extending from three to twelve inches below the surface.



In the open spaces, kept clear of ice and snow by the sprays, the birds do their feeding

The filter bed in mid-winter, with the sprays in operation

The most successful method yet devised for the control of the filter fly was worked out in the New Jersey Agricultural Experiment Station, and consists in flooding the filter bed with the incoming sewage (by closing the outlets) and then leaving them completely submersed for a period of twenty-four hours. Such treatment of the beds kills the *Psychoda* larvae and pupae by drowning.

While engaged in some investigations for the State of New Jersey on the animal population of the filter beds of the Plainfield, N. J. sewage disposal plant, the writer had opportunity of observing the various stages in the growth of the filter flies, and also of noting a singular and hitherto apparently unappreciated natural check upon the growth of these noxious forms. This natural check is the work carried on during the winter, by several species of native birds, namely the song sparrow (*Melospiza melodia*), the goldfinch (*Astragalinus tristis*), the tree sparrow (*Spizella pusilla*), and the junco or snowbird (*Junco hyemalis*). Flocks of these birds numbering from fifty to one hundred and fifty individuals were often seen flying about the filter beds, with the juncos and song sparrows much the most numerous. At times two or more separate flocks were observed about the beds, making a total of about three hundred birds. Close attention to their movements showed that these birds were securing food from the surface of the filter beds, working rapidly between the periods of the activity of the sprays, which were of two minutes' duration. Microscopic examination of the film showed few or no weed seeds, which are the chief constituents in the dietaries of the birds mentioned. The only larger forms of life present in or on the film were the filter fly adults and young, and it was these forms for which the birds were in search. From observations of their feeding activities it was judged that each bird secured one bit of food (presumably a *Psychoda* adult, larva, or pupa) every two seconds, making thirty individual organisms per minute for each bird, or 1800 per hour. This would make a total of 270,000 organisms per hour for a flock of 150 birds, or over half a million where the number of birds was 300. And if only 150 birds were at work on the filter beds, let us say four hours daily, the number of organisms consumed would total 1,080,000! Thus flocks of birds working on a filter bed during the entire winter would aid in a material way in keeping the *Psychoda* flies in check.

Fighting Forest Fires with Radio and Plane

IN fighting devastating forest fires in northern Ontario, Canada, man's conquest of the air is playing an important part. Today eight planes are engaged in daily aerial patrols over more than 80,000 square miles of virgin timber. The planes make their headquarters at Ramsay Lake, Ontario, where the provincial government in conjunction with a privately operated air service maintains the first radio station devoted to fire patrol service in middle northern Ontario.

The annual loss of standing timber by forest fire in the Ontario regions has been appalling. The losses have increased annually by almost a million dollars. There are few settlements in the timber belt hence no men to range the country for fires or to fight them. This year, it is announced, the loss will be cut by a million dollars. The cooperating radio and planes are given credit for the favorable change.

The planes in use are the SE type, manned by ex war aviators, one of whom was an ace in the Royal Canadian air forces. Four of the eight planes are equipped with radio transmission sets and the others will have them in a short time. The power for transmission is derived from a generator driven by a separate small propeller.

The aerial for broadcasting is on a coil in the cockpit and the end is tied to a weight so that when the plane has taken to the air the aerial is paid out about 100 or 150 feet. The weight keeps it suspended downward without interfering with the propeller. A fifty watt oscillating power tube is used and the circuit is of the well-known feed back type for transmission. Generating power is as high as 1000 volts. The sending is about 555 metres but can be raised to 900. It is most practical to send on a very high wave.

The communication established between plane and the radio station built on a rock in Ramsay Lake, enables the patrol, which first sights the fire, to call other planes into fire fighting action. When an observer flashes the ground station that fire has been sighted he gives map co-ordinates, and planes with specially built, gas driven centrifugal pumps and as much hose as the plane will carry, are dispatched to fight the fire.

Frequently it has occurred that planes were unable to find a landing place near the fire and have been forced to drop pumps into shallow lakes. A buoy is attached in this emergency and later the pump is fished out and put into service. Several times bombing from the air has been resorted to where the fires were discovered too late for a small pump to be of service.

Psychology and Criminal Responsibility

IN A recent number of *Psyche*, Dr W Brown discusses the attitude of modern psychology to responsibility. He shows that there is a tendency for those who understand incompletely the aims of modern psychology, to believe that a general spread of its doctrines will result in a weakening of the sense of moral responsibility. He discusses the legal definition of responsibility and describes cases where a crime of violence may be committed for which the person cannot be held responsible. The psychologist, as such, is concerned with the problem of studying the causes in the history of the person which have led to the act and the contribution of recent work is in the direction of tracing the influence of the acts and phantasies of infancy and childhood. It appears not infrequently that the people answerable for the victim's upbringing were really responsible. Modern psychology does not contest the reality of moral responsibility. While it holds the view that criminals suffering from certain forms of mental disease are less fully responsible than are normal people, it does not countenance the view that all criminals suffer from mental illness, nor that mental illness is an invariably sufficient excuse for crime.

German trailer with steering gear, designed to carry the other end of long loads, and keep the big poles out of mischief on the corners

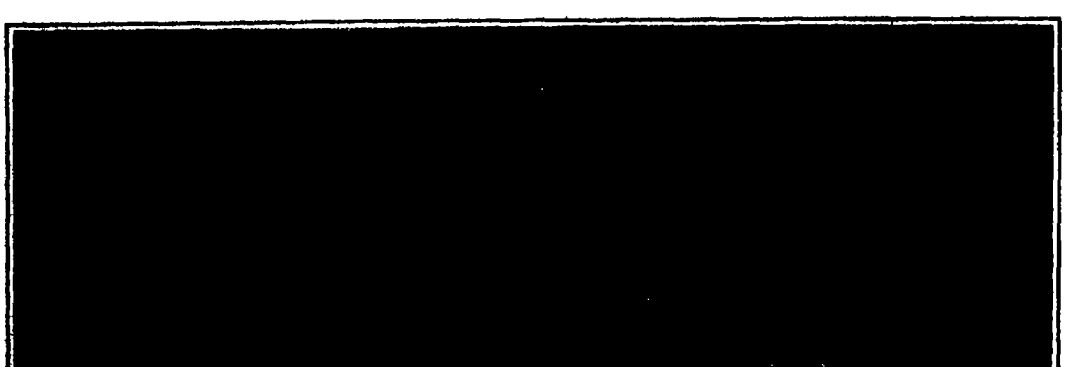
Where the Load Carries the Trailer

THE transportation of extremely long structural units—poles, girders etc.—is always a problem. We have seen traffic in New York completely disorganized by the passage through the streets of the huge girders for the bridge across 42nd St., joining the concourse around the Grand Central Station with the central roadway of Park Ave. These are the longest single loads that have ever been attempted in this city, with the exception of the obelisk in Central Park, and this was taken up from the docks to its present location many years ago at a time when horses were the only available motive power and traffic was far from its present congestion.

Canadian fire patrol returning to his base after nine hours of continuous flying in cold air

The mere presence of an extremely long load on the road is in itself a good deal of a nuisance, complicating as it does the problems of passing. But when such a load reaches a turn we find it at its worst. All the difficulties and dangers cannot be eliminated of course; they are inherent in the situation. But we present two pictures showing the use of a special trailer now being made by the reformed Krupp works in Essen, Germany, which is especially designed for this sort of thing. The upper view, showing it handling a load of poles, gives the best idea of how it works and the very daring stunt of the lower photograph in which a completely assembled steel tower of considerably more than fifty feet is being handled, shows the extreme possibilities.

As the closer view suggests there is no physical connection between truck and trailer other than that afforded by the load itself. This of course is quite sufficient to hold them together. In negotiating a bend, it is not feasible to permit the trailer and the end of the load to cut the corner as they would if left to themselves and as the rear wheels of the ordinary car and truck now do. The trailer has to track more or less closely after the truck and so it must carry its own steering gear and its own steersman. The pole picture gives a very good idea of the behavior of the trailer and of the load under these conditions.



A spectacular piece of hauling that was successfully engineered with the steering trailer. Note the absence of any connection between truck and trailer other than that afforded by the load itself

Clothes Moths and Their Control

AMONG entomologists there are well known to be two very common moths the larvae of which are destructive to fabrics, namely the case-making clothes moth and the webbing clothes moth; the tapestry moth is much less frequent but is occasionally destructive.

In general the larvae of clothes moths feed upon wool, fur, feathers, hair and all fabrics manufactured from them. It will therefore be realized that they may be found attacking not only clothing but also carpets, rugs, furs, upholsteries, stuffed animals, brushes, felts in pianos and the like. The moths are relatively short lived; they take no nourishment and are in themselves harmless. Their eggs are laid upon or between folds of fabrics or within the meshes of the latter. They are readily crushed by brushing etc., and are very fragile. Under average indoor conditions they hatch in about a week, this period being subject to lengthening or shortening according to temperature. The larvae are relatively long lived and require from about fifteen weeks to two years to complete their development. Much depends upon the nature of the material upon which they are feeding and the temperature conditions under which they exist. The pupal, or resting period varies from about eight days in warm summer weather to a month or more in winter.

Methods of dealing with these pests are numerous. Fabrics that are well brushed or beaten every two weeks are seldom seriously affected; exposure to direct sunlight is also a valuable measure. Articles of clothing that require to be stored are immune from attack if sealed down in paper bags or very securely wrapped in several layers of quite unbroken newspaper. Naphthalene in the form of flakes or balls should be placed among the clothing thus fastened up. It also acts as a deterrent when placed in drawers or cupboards, but is not entirely effective under such conditions. Paradichlorobenzene appears to be as valuable as napthalene, but camphor is decidedly less effective.

On a large scale the cold storage of furs, carpets, and furniture is the most certain of all preventives. An effective remedy which is also non injurious to furniture, fabrics, plate or other household goods, is the application of hydrocyanic acid gas. Its manipulation requires the services of an intelligent person who understands the dangers of its use and knows how to administer it. Carbon tetrachloride is also effective, and has the advantage over hydrocyanic acid gas in being neither explosive nor inflammable. Fumigation with sulfur is a well known remedy, but there is some danger from fire in its application while it has a bleaching effect on many delicate fabrics, wallpaper, etc. besides tarnishing metals. Carbon disulfide is also recommended but its vapor is inflammable. Dry heat is now recognized as an effective agent. All fabrics will be freed from pests in a very short time if exposed to a temperature of 130° F. Fabrics dipped in water heated to 140° F will be found to contain no living eggs or larvae of clothes moths.—*Abstract from article by A. D. Imms in Nature, December 15, 1923.*

Uncle Sam's High-Priced School

ONE of the highest priced schools in the world is operated by Uncle Sam himself, at Madison Wisconsin where each registrant pays $100 for a one week course at *the rate of $5,200 a year for tuition alone* There may be occasionally heavier collateral bills for the college veneering of coltish boys and girls with jazzy tendencies But this federal school is for hard-headed business grown ups

It is conducted by the Forest Products Laboratory, the technical wood usage department of the Forest Service Its four instructional courses given three times yearly, cover that number of broad fields of wood use and adaptation, the specific courses being Kiln Drying of Lumber, Boxing and Crating Gluing of Wood, and Wood Properties and Uses

Practically everybody feels that Nature has already given him the essential facts about wood It's a tall tree stuff that grows outdoors they use it for Christmas trees and boxes and houses it rots and needs interminable painting and paint costs big money and raucous agitators shout "Woodman Spare that Tree and Save the Forests and many other noisy words And yet the Laboratory's skilled investigators have found out and *put into these lecture courses many valuable things* that the average wood authority doesn't yet know

About 400 000 houses are built in the United States every year 98 per cent of all farm and rural houses are still built of wood, and fully 75 per cent of all in the cities How long should a wooden house stand? About 80 000 American buildings are destroyed yearly Fire and decay are important factors in this destruction Indeed the total annual wood loss by decay alone almost equals the present growth in all the American forests The Laboratory shows that decay is the growth of living fungi that can be largely controlled by knowing what decay is and how to preserve the wood or to build so that decay does not start

During fourteen years of intensive study the Laboratory has made more than 600,000 strength tests of woods Just how strong should structural timbers be? A large building failed as it was approaching completion It was through the mercy of God and not the builder's wisdom that men were not killed Did the *architect understand wood strengths well enough to provide sufficient margin for safety?* The Laboratory, when appealed to, showed that failure had been due to overload even before the building was finished, and that not enough margin had been allowed for safety Many buildings fail disastrously through lack of knowledge of wood strengths

A telephone company experienced serious losses in shipping its switchboards Could the Laboratory, from its fundamental knowledge of boxing and crating, suggest packing methods to prevent this breakage loss that the telephone public must pay? A trunk manufacturer wanted to build a trunk that would defy the baggage-smasher He sent some $50 trunks for the Laboratory to test to destruction, and find the weak spots and how to remedy them

A lamp-chimney maker encountered an excessive shipping breakage Was there not some way to pack fragile lamp chimneys so that they would travel safely and cost the people less money? Too great loss was *occurring in the shipment of automobile tires and tubes.* The Laboratory used up $3,000 worth of new factory rubber in showing how these goods could be shipped safely These are a few of the many cases in which the Laboratory has cooperated with manufacturers to solve difficult problems that affect almost every home and that help furnish the data for a great technical school

The railroads were paying $00 000 000 a year for freight damaged in transit Laboratory investigation showed that greater shipping safety might be had by adopting proper principles of container design, in the application of bracing banding and nailing methods A campaign for better packing and handling cut the loss by $45 000,000 in one year

What kind of wood does one actually get when buying by name? Sometimes it is important to know One company bought some sawdust for an especial use The shipment did not seem to meet the visual requirements, and the buyer protested Microscopic analysis at the Laboratory showed that the consignor had sent what was ordered and the dispute was easily adjusted.

A county *officer was the victim of a bomb that* crippled him and killed his wife Suspicion pointed to a man with whom the county had had trouble A piece of wood was used in constructing the bomb Some of the shattered splinters were sent to the Laboratory for identification. The suspect's workshop contained shavings of the identical kind of wood, and as a result of this and other evidence conviction was secured

For its last dry kiln course the Laboratory had 25 students from 14 states and two foreign countries. Other courses are for one week only, the kiln course lasts two weeks and costs $150 Already this one department has had more than 300 students.

Kilns for drying lumber have been used in the United States for three decades, but have come into really great prominence only in the past few years. Lumbermen and wood users are finding them more and more an economic necessity Comparatively few students come to study for initial kiln installation they want *to know how to operate their present plants better* The Laboratory for the past 13 years has made an intensive study of dry kiln methods, and its kiln-drying specialists have a world wide reputation It has itself developed several basic kiln patents which are formally dedicated to the public It is the nation's and the world's dry kiln schoolmaster

With a thousand blank pages in the popular book of knowledge concerning woods and wood uses that only the Laboratory can fill, the appropriations still contemplate nothing but research work Instructional service can be rendered only through the cooperation of those sufficiently interested to pay the enrollment fees The instruction is given on a far less-than-cost basis for the extra service, by men recognized as national authorities in their particular lines of investigation, to give the business world every Laboratory method, every discovery of value, and put it to work

The War Department Radio Net

ALTHOUGH easily the most extensive and perfected radio communication system in the world today, this net has been little known to the public The great network tying in every city of tactical importance in the United States with Washington and with the nine Corps Area headquarters, was planned as a training measure and to provide communication during any local or national emergency during which land lines might fail It was given as little publicity as possible until its seventy five stations could be installed and welded into a smoothly working system, free from interference and causing none to other stations

The net has its origin in the "Army Radio Net" as employed in the First and Second American Armies in France, prior to the Armistice of 1918 The Signal Corps, therefore lacked neither inspiration nor experience in its creation, for the Army nets in France were created and operated in an atmosphere of enemy interference beyond comprehensive description

The project was approved by the Secretary of War, March 12, 1921 At the very outset the Signal Corps had the distinct advantage of being able to start with the most modern continuous wave equipment available in the world No obsolete spark equipment had to be patched into an otherwise perfect pattern Remote control of transmitters providing simultaneous or multiplex transmission and reception was known to be as necessary as power to operate the transmitters, and was provided The first receiver installed in the net employed a directional loop with a six stage radio-audio frequency amplifier and external heterodyne Nothing new in the art was overlooked in the initial engineering plans nor has anything since been over looked which might improve the net's efficiency

All stations are within military posts where they can be guarded Auxiliary sources of power supply provide emergency power in the event of failure of a commercial source and spare parts are provided so that failure of a vital unit is never serious

With one exception all stations of the War Department net are radiophone as well as radio telegraph this feature being provided against possible future requirements

The War Department net proper connects the nine Corps Areas of the United States with each other, and with Washington Each of the nine Corps Areas has its own comprehensive Corps Area radio net connecting with its headquarters all tactically important points within the Area

The American Radio Relay League, with its vast network of efficient short wave stations ever on the alert for patriotic service, and officered by men prominent in the radio art, has proposed to the Chief Signal Officer of the Army the tying in of specially selected stations of their great organization with nearby stations of the War Department and Corps Area nets The significance of such an accomplishment can only be realized gradually Every village, town and city in the United States would be connected by a highly organized efficient system of radio communication, which could be interrupted by no conceivable disaster

The recent installation of specially designed high power vacuum tube transmitters at Fort Leavenworth Kansas, and Fort Douglas, Utah is of prime importance These two stations and Washington have been provided with automatic high speed transmitting and receiving equipment Both Washington and Fort Douglas will control the Fort Leavenworth station by automatic radio relays and will thus not only be able to communicate with each other, but with any station capable of being reached by the Fort Leavenworth station A later article will describe this equipment and the work accomplished therewith

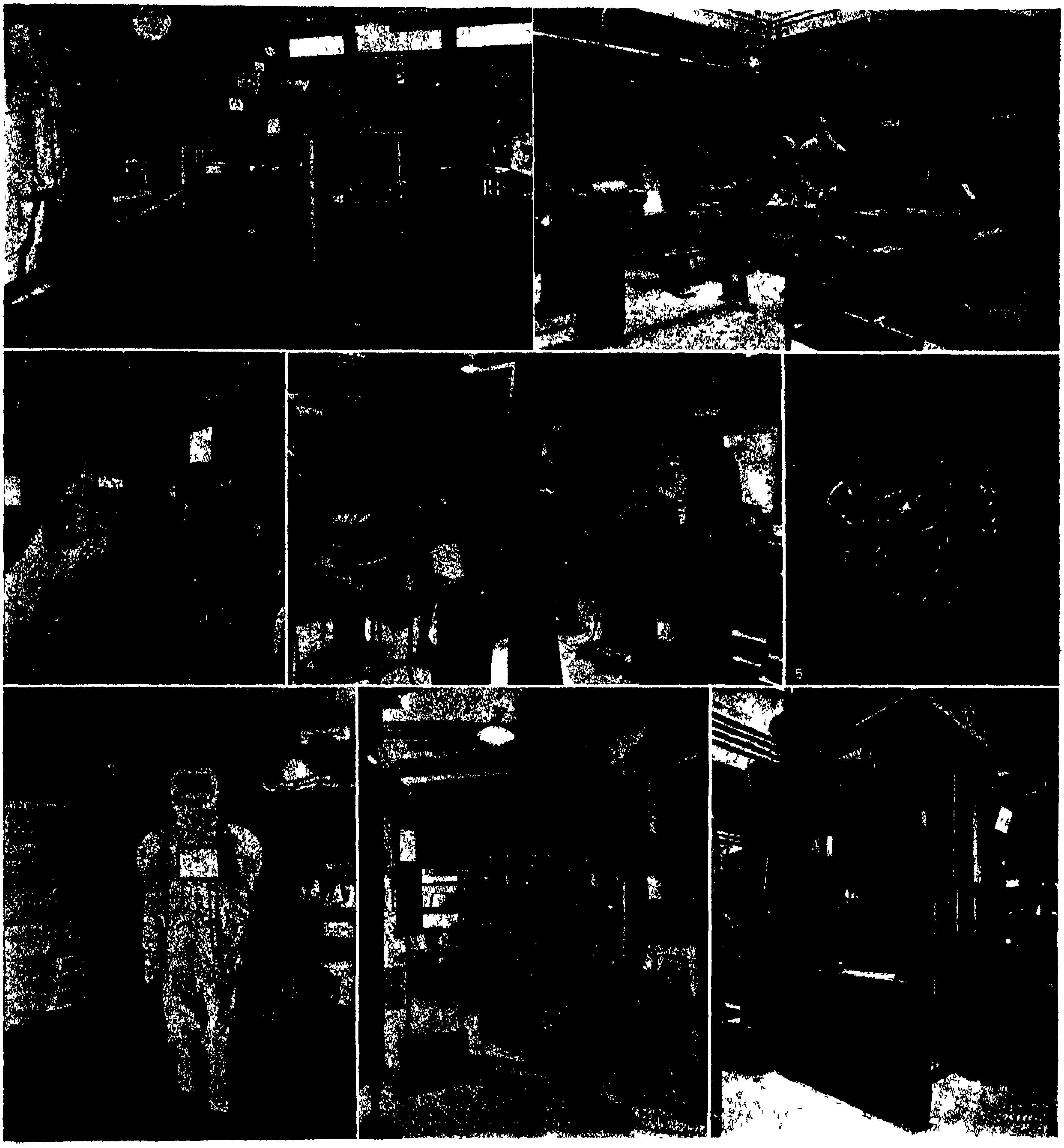
While the War Department and Corps Area nets were provided for training and emergency purposes, it is obvious that any communication system so complex and far reaching must function continuously in normal times to be able to function at all in an emergency For this reason, and for this reason only, the War Department and Corps Area nets handle the dispatch traffic of the War Department Veterans Bureau and the Navy between points in the interior of the United States Incidentally, by so doing, the government effects a net saving in telegraph funds over and above all operating expenses except enlisted personnel, of approximately $120 000 per annum Finally, by extensively *training many young men to operate real radio* stations it saves the Army from a repetition of that very discouraging situation along the American battle-front in France, where many such young men were needed, and few obtainable.

The Nature of Muscular Fatigue

NEARLY all the recent and important advances in muscle physiology have resulted from a study of the phenomena of fatigue We all know that there is a limit to muscular exertion, a limit which is set by *what we call fatigue If an able-bodied* man take exercise at a very small rate e g by walking he remains comparatively untired for long periods, if he takes exercise more violently he becomes tired more quickly, if he exerts himself with the extreme effort of which he is capable, he is completely exhausted in less than a minute There are many different kinds of fatigue, but the one from the study of which so much light has been shed on the nature of muscles, is the extreme athletic fatigue that results rapidly from very violent effort By it the finest athlete in the world may be overcome within a minute

This fatigue is a simple and comparatively intelligible thing It can be reproduced readily in isolated muscle For example let an isolated frog's muscle be subjected, every second or two, to an electric shock, and its contraction be recorded We find that the response changes in a regular and progressive way, the force exerted becoming less the contraction developing rather more slowly and continuing much longer, and the relaxation being much drawn out Finally, the muscle becomes inexcitable Now in the intact animal, in man we know that even extreme fatigue is rapidly recovered from and this recovery is attributed to the circulation If the circulation be hindered by a cramped position recovery is slower If the fatigued isolated muscle be left in a chamber free of oxygen, no sign of recovery occurs, if, however, it be left in oxygen, in a few hours complete recovery will take place, and the muscle will now be capable of repeating its previous effort

The realization, especially by Fletcher about 25 years ago of the extreme importance of this observation led directly to the most striking advances in our knowledge of the working of muscle Recovery from fatigue is possible only in the presence of oxygen, and it was natural to suppose that the oxygen was used to oxidize some water product, the presence of which acted unfavorably on the muscle. The next great step was due again in part to Fletcher, this time in cooperation with Hopkins Lactic acid was known to occur in muscle, and Fletcher and Hopkins found the lactic acid to be increased by exercise, and diminished or abolished by recovery in the presence of oxygen. Furthermore, there appeared to be a certain definite maximum, beyond which the lactic acid content of the muscle could not be driven, even by the most vigorous stimulation clearly this corresponded to the maximum effort a muscle could make—*Abstract from article by Professor A. V. Hill, F R. S, in Nature for July 14, 1923*



NEW YORK has the latest safety museum. There are only three in this country although there are many on the Continent of Europe. The new museum is operated by the American Museum of Safety in cooperation with the Department of Labor of the State of New York, and Mr Albert A Hopkins of the Editorial Staff of the SCIENTIFIC AMERICAN, is the Director Exhibits may be broadly divided into two classes, namely, still exhibits, such as protective clothing, goggles, respirators, etc., and moving machinery properly guarded The above view 1 shows the former class of exhibit and 2 the latter The Machine Room has all kinds of metal and woodworking machines which are demonstrated to the visitor showing where the hazards are and how they may be corrected The punch presses, 3 are good examples of proper guards for the actuating mechanism and at the point of operation The "Grinder Family" 4 is not hazardous if well protected The SCIENTIFIC AMERICAN awards a gold medal annually for the best device recently invented and exhibited in the Museum Our view 5 shows the face of the medal The Asbestos Man 6 invites us to descend to hotter regions but does not look very comfortable. View 7 shows how the dangers of electricity are avoided and how men can safely ascend heights by means of a boatswain's chair View 8 is a specially constructed elevator which actually operates to show various types of interlocking door The motor lifts the counterweights

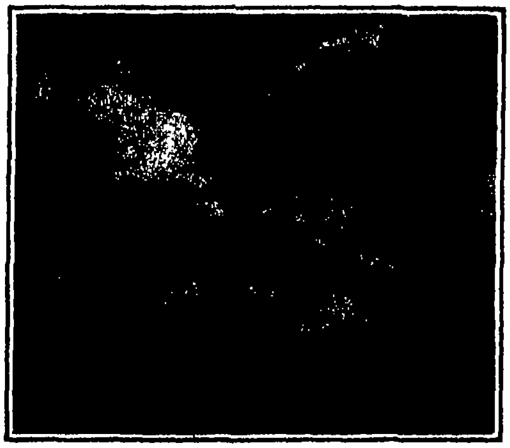
DEDICATED TO THE SAFETY OF LIFE AND LIMB: THE SAFETY MUSEUM IN NEW YORK CITY

The Sky by Day

Solved and Unsolved Problems Which It Places Before Our Eyes

By M Luckiesh

Director of Applied Science Nela Research Laboratories.



A typical bank of cumulus clouds

PERHAPS the "night sky" has more persons thoroughly enchained by its stellar interest than the "day sky." The night sky with its infinite magnitudes and numberless shining bodies not only awakens the imagination but by its infinitude provides an endless area for its play. But the day sky is full of scientific interest, of artistic charm and also of large-scale phenomena. It is an ever present portion of landscapes and seascapes and, expressing the mood of Nature, it provides interesting variety for those appreciative of the beautiful. But passing by this fascinating phase of the day sky let us glimpse some of its great variety of phenomena from a scientific viewpoint.

We live at the bottom of a great ocean of air which exerts a pressure of about one ton on every square foot of earth. The liquid oceans are full of currents great and small. Likewise great currents of air similar to the Gulf Stream flow from equator to poles and back again over fairly defined routes. Superposed on these are effects of land, sea and season. And upon the whole is superposed a mass of eddies and convection currents depending upon the topography of the earth's surface and upon weather. In fact the air currents might be said to be partially the cause and to some degree the effect of weather.

One of the day sky's phenomena which is usually taken for granted is the blue sky, but this aspect has commanded, even in recent years, the attention of some of our best scientists. Here we have a large scale example of the selective scattering of light by small particles. Just as the smoke from the burning end of a cigar is bluish so is the sky. But the smoke after being drawn into the mouth and exhaled is no longer blue. Moisture has condensed upon the particles increasing their size, thus decreasing their selective scattering. So it is with fog. But the last scientific word in regard to the blue sky has not been uttered for at great heights, where dust particles and water vapor are rare, a deep blue sky still exists. In the high regions the scattering is likely done by the molecules of gas. If so we have here an exhibition of molecular scattering of light on a tremendous scale unapproached in any experimental research devised by man. It is little wonder that science turns to the blue sky for the answers to certain questions of molecular phenomena.

Then we have the ever-changing clouds—the sign posts on the highways of the winds. They make air currents visible by their movements. They make visible the eddies and convection currents by their forms. In connection with the rise and fall of the barometer they foretell weather conditions. When long streamers of tenuous clouds spread toward the east across the sky, apparently converging at their source beyond the western horizon they herald the approach of a storm area if the barometer is falling. They are born in the cradle of a cyclonic area of low barometer pressure. The masses of air converge toward this "low" and the moisture laden air is forced upward to great heights into the region of perpetual high winds. Thus they are carried far in advance of the slowly moving "low" and notify the cloud wise that a storm area is following them.

On a hot sultry day the sky is likely to contain thunderheads rearing their cauliflower crests into the heights. When one of these appears off toward the southeastern horizon it is something well worth watching. It is everchanging and mounting higher. The form of its crest reveals to the observer the powerful upward convection currents which stretch the great mass of cloud into the high regions of intense cold. Here hail is born. Here is the genesis of lightning but how? This question is not thoroughly answered. As we watch this huge cloud mounting higher and higher many other cloud phenomena are occurring. A layer of cloud may appear at the crest owing to certain conditions of temperature and humidity. But the crest moves gradually upward through the "scarf" cloud. Finally a fragment may be torn from the crest, waving like a banner for a moment then drifting away to be devoured by thirsty air. Such a cloud is full of scientific interest to those far enough away to view its profile. Those underneath are lashed with hail and rain and many are terror stricken by the lightning and thunder. Do we realize that we were viewing a cloud-*mountain* higher than any mountain on our earth? These thunderheads sometimes rear their crests ten miles above the earth.

Lesser antics of clouds are often to be seen. We lounge lazily on the beach on a warm day and watch the small fair weather cumulus clouds drift inshore.

A fragment being torn from the crest of a huge thunderhead

When they reach a position over the shore they may be torn and pulled violently upward. Their antics demonstrate the existence of powerful upward currents rising from the heated earth which pulls the air inshore, hence the sea-breeze. Land heats and cools more rapidly than water, hence the sea breeze by day and the land breeze by night at certain seasons.

Then we have the chaotic sky in early spring or late fall when many kinds of clouds are present. It appears like a great stage on which properties are being rushed to and fro in preparation for the next act. High up over the horizon we may see a snow-storm. The falling snow is bright in the sunshine but its appearance may end like goat's whiskers. The thirsty air has drunk up the snow flakes before they fell far. In another place we may see a cauliflower head rising into the sky but it will not attain the height that it would in the hotter season. Here and there throughout this chaotic sky are many secrets being revealed to the cloud wise observer and there are many opportunities for scientific conjecture. The clouds offer numberless opportunities for exercising the analytical mind and always repay the observer with a variety of interest.

We have various optical phenomena such as the halo and the corona encircling sun or moon. The high clouds always consist of ice particles. When a sheet of these passes between us and the sun or moon, a halo of definite size, usually of 22° or 46° radius, will encircle the luminous body. The corona is formed by diffraction of light by droplets of water in lower cloud-sheets. These optical phenomena including the rainbow offer plenty of scientific interest pertaining to refraction, diffraction, and reflection.

Along toward the latter part of the afternoon when there are plenty of clouds in the sky we often see the streamers of sunlight passing through the interstices. These huge rays of light appear fan-shaped and apparently converging toward the sun. Here is a gigantic illusion of perspective which is recognized by few as such. These rays are *parallel* and cannot be otherwise because they emerge from the sun which is practically at an infinite distance. Here is food for thought and an opportunity to surmount the illusive effect by a true mental image from which perspective has been banished.

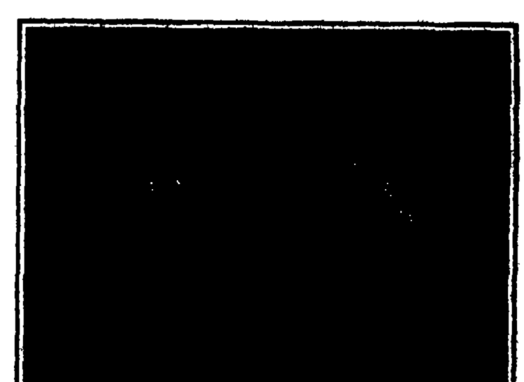
As the sun lowers toward the horizon it reddens and the variety of different colors is interesting. Various portions of the clouds receive light directly from the sun, from the blue sky, by diffusion through the cloud, and in various other ways. The effect is changing due both to the setting of the sun and to the movements of the clouds. Here is a great display of colors, the unraveling of which into the components of the mixture is sufficient to satisfy the most analytical mind.

After the sun has set, the progressive color scheme is still visible if clouds are present at various altitudes. If we could view the beam of direct *sunlight in profile* we would see the lower portion red, the next higher orange, the next yellow and so on. As the minutes pass by we see any given cloud colored in the reverse order until finally the highest wispy cirrus clouds are bathed in red light—the last lingering rays—about twenty minutes after the sun has set for us on the earth. Here are geometrical problems of much interest.

Once in Iowa during an unusual period of dryness and absence of clouds great shadows passed across the sky which persisted for an hour or so after the sun had set. Not a cloud appeared in the sky for eight days and each evening these shadows appeared. The same cloudless period was reported in the states to the westward and across eight hundred miles of prairie to the Rocky Mountains there is no great body of water over which clouds might hover. These shadows were fascinating as they appeared each night after a cloudless day. How were they formed? Could they be the shadows of the Rockies nearly one thousand miles to the westward! The application of geometry to the approximate distance and altitude of the Rockies, indicated that the sun's rays passing over the crests of the mountains and tangent to the prairie east of the mountains, passed over Iowa at a height of about sixty miles. This is still in the region of air and other particles and therefore it is possible that the shadows of the Rockies were seen nearly one thousand miles away! The day sky is always presenting questions.

As the sky fades after sunset the last flush of daylight disappears when the sun has set for an imaginary individual at an altitude of about one hundred miles. The duration of twilight gives a direct measure of the height at which atmospheric gases exist in sufficient quantity to reflect an appreciable amount of light. The twilight limit is far above the beginning of the region

(*Continued on page 438*)



A thunderhead five miles high

New Ideas of Prehistoric Flora

FORMERLY geologic time was measured in millions, later in hundreds of millions of years, now it may have to be reckoned in thousands of millions of years. This revision of ideas has been suggested by the discovery that flowering plants which had been supposed to be relatively modern grew way back in the coal age. A "coal ball" discovered by Dr A C Noé, paleobotanist of the University of Chicago, in research work in American coal fields has brought this startling fact to light.

Coal balls are round limestone balls varying in size from a walnut to a cocoanut. They are found in coal beds and contain perfectly preserved plants fossils of the same kind of plants which formed the immense coal fields of the world. If these balls are cut with a power saw into small blocks and these in turn are sliced to thin sections with a diamond saw and then reduced to minute thinness by grinding they reveal under the microscope the plant cells, fibers and organs in exactly the same forms as if they were still alive.

Coal balls were found as long ago as 1835 in England and northern France, and it is on the microscopic study of these by European scholars that the entire knowledge of the vegetation of the coal age of the world's evolution is based.

It was not until 1922 when Dr Noé discovered coal balls in coal seams in Illinois and Kentucky that any had been found in America. They have since been discovered in Texas and Dr Noé has found them in Indiana and Iowa. One collected in Illinois has revealed under the microscope the stem of a highly developed seed plant similar to a cornstalk.

All previous study of coal balls had given the information that plant life of the coal era was of a low order, consisting of ferns, club mosses and plants of the horsetail family which in an atmosphere saturated with vapor grew to the size of immense trees. No seasonal rings such as are found in modern woods have been discovered in the fossil remains, giving proof that it was eternal summer those days or better, in view of the humidity, eternal spring.

From the knowledge of coal plants and the conditions under which they grew acquired by study of coal balls, scientists have been able to reconstruct ideal landscapes picturing the world as it must have been in the age when coal was formed. The discovery now of a highly developed flowering plant in an American coal ball indicates that other forms of life should variegate the landscape. But mostly it upsets all previous conception of the age of the world.

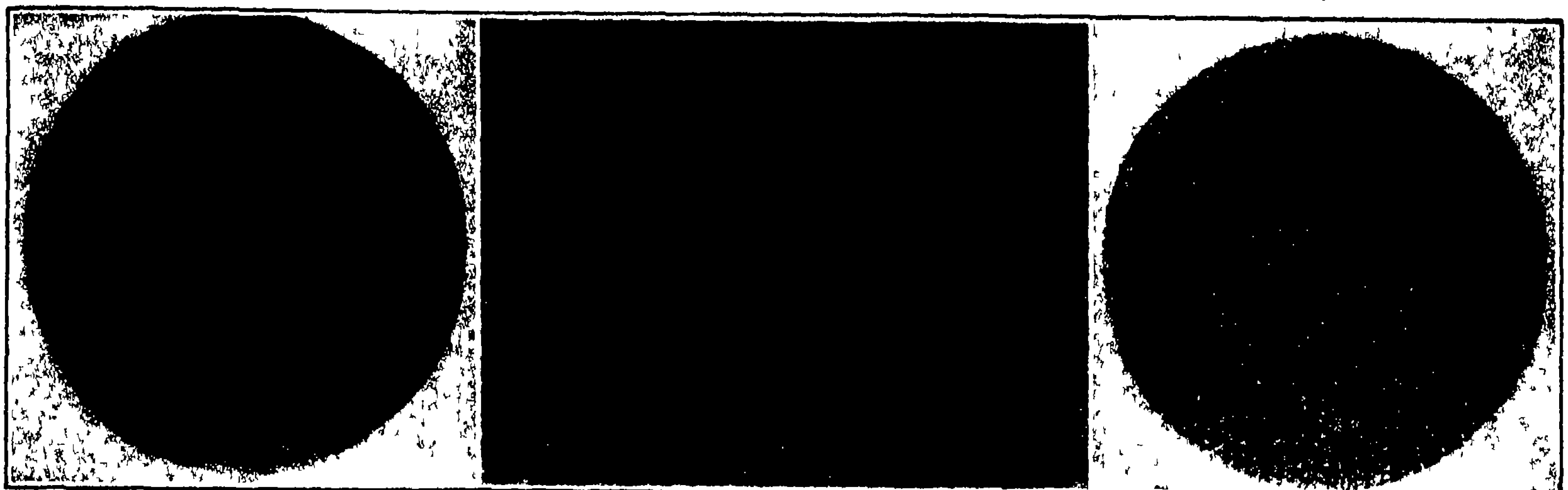
"Over a thousand million years must have elapsed," says Dr. Noé, "between the origin of plant life on earth and the stage of evolution reached at the time when the coal was laid down. The time since the coal age is now figured as several hundred millions of years. The existence of highest forms of plant life in the coal age shows that the time which elapsed between the origin of plants and the coal age must have been much longer, probably ten times as long as the period since the coal age.

A Tree with Engineering Judgment

IN our school days we were taught that the banyan tree sends down shoots from its limbs which take root in the ground; but we do not recall that anybody ever attempted to tell us why this was done. The picture adjoining will perhaps lend a suggestion here.

Banyan tree of unusual proportions, at Palm Beach

It seems fairly obvious that these immense spreading branches, extending for many yards from the parent trunk without any of the gradual reduction in sectional size which usually is noted under parallel circumstances, would not support their own weight if this were all to be thrown upon the limbs themselves. It looks very much as though at least one of the functions of these very sturdy secondary root stalks were to act as props. In other words, the banyan tree must be cited as another demonstration of Dame Nature's engineering instinct.



Left: Section of the divided stem of a coal-age tree found in a coal ball. *Center:* Tree-bark from the coal age, which has come down to us preserved in a coal ball. *Right:* Section of wood from a tree of the coal age 50 times magnified. Since there were no seasons in those days, only an eternal spring, the seasonal rings of present-day trees are missing

What the coal-ball fossils tell us of the vegetation of the days in which the carboniferous strata were laid down

The Origin of Petroleum

UNLIKE most problems concerning origins, that of the genesis of petroleum has a distinctly practical significance, for if solved, prospectors for mineral oil would be provided with important data and chemists might learn how to produce artificially valuable substances similar to if not identical with, natural petroleum. Explanations that affirm a cosmic origin or postulate volcanic activity as the effective cause have long been abandoned, and today there are only three which find scientific support. The least popular of these, the inorganic theory, affirms that petroleum originates from the interaction of metallic carbides, presumed to exist immediately below the earth's outer crust, and steam whereby various hydrocarbons are formed which then undergo further changes.

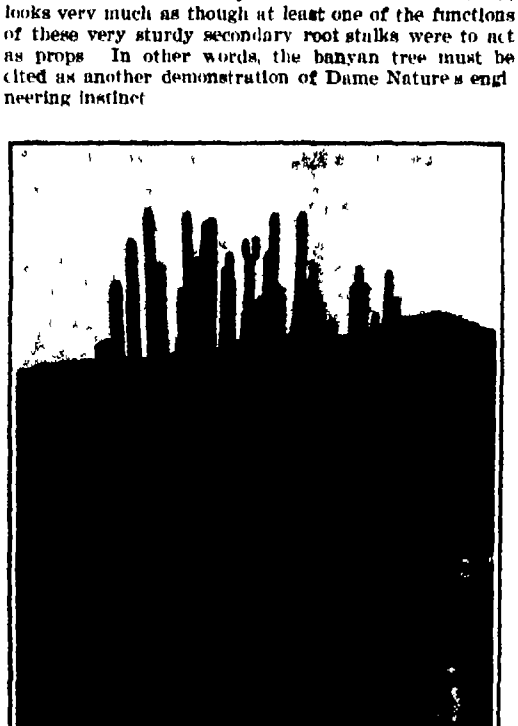
The views that are uppermost today are that petroleum is derived from either animal or vegetable substances, or from both of these sources, and the chief direct evidence supporting this organic theory is the occurrence in petroliferous strata of vegetable and animal remains, including in a few cases remains of bacteria. The various elaborations of this view are mainly concerned with the nature of the chemical reactions involved and how they are influenced by the three determining factors of pressure, temperature and time.

The evidence admitted by those who believe in a purely animal origin includes the statements that petroleum found in primary rocks is much more often accompanied by animal than by vegetable remains, that formations containing only plants are not bituminous, that mixtures of hydrocarbons similar to those found in petroleums can be made artificially from animal fats and that such production can be observed in Nature today notably in the coral reefs and lagoons of Djebel Zeit in Egypt. The scarcity of animal fossils in petroliferous strata is explained by assuming that the fauna were either skeletonless, or, if not, that their calcareous coatings were dissolved by the carbon dioxide liberated during their decomposition. Advocates of the vegetable origin doubt if the supply of animal matter has been sufficient for the purpose, they comment on the absence of phosphatic deposits from the vicinity of oilfields and they trace relationships between coals and petroleum.

Supporters of the vegetable theory maintain that geological evidence is accumulating in support of the view that coals and lignites are related to petroleum. Thus in numerous cases the main oil bearing horizons have each a carbonaceous phase in some other district, and the petroliferous and carbonaceous phases approach each other very closely in some localities.

A Giant Cactus

THAT tropical vegetation grows far more luxuriantly and to far greater size than that of temperate zones is a truism, but perhaps an illustration of the fact will not be out of place. For such purpose we can use nothing to better advantage than the accompanying picture of an organ cactus that is to be found along the railroad line south of Mexico City. No statement of its size accompanies the print which reaches us but the men in the foreground will afford the inquisitive reader the raw material for a rough scaling off which will demonstrate that the huge spine bush is at least 25 feet high. The specimen in question has attained considerable local fame, and is spoken of by the cameraman as one of the most picturesque in the world.



One of Mexico's prize cacti

Snowslides

Some Facts about Their Menace and Their Prevention

By D S Olson

Chief of Planting United States Forest Service

A double slide in the Coeur d'Alenes, meeting at the bottom

THOSE who have toured the Yellowstone Trail between Spokane and Missoula remember a desolate stretch of dead forest—mile for mile as far as the eye can see a million acres, a billion bleached and blackened trees monuments of once living virgin timber The old story—a forest fire

There's another picture in the winter time of the same mountains—a winter scene more desolate No green mat on the hillside no shrubs along the road and banks of streams Only the forest of 'telephone poles, standing like sentinels in the mantle of snow on the bleak mountain slopes And in that country in the winter time this condition brings a menace to lives and property—snowslides

The reader is aware of the importance of tree growth and other vegetation on steep slopes in holding the soil directly by a fine network of interlacing roots and indirectly by retaining moisture in the spongy mat of roots and leaves thus overcoming the danger of erosion from spring freshets In a like manner the forests protect the slopes from snowslides

For ages snowslides have occurred but in this country their menace has not been felt until in late years Public lives and property are the toll Railroads particularly are endangered when the snow begins to slip

Railroads have suffered heavy losses in this region from snowslides and the impressive fact is that conditions on this 1910 burn will not improve in the near future but become worse because the standing dead timber is gradually rotting and falling to the ground Standing trees living or dead if sufficiently dense hold the mantle of snow on the ground from sliding even on the steepest slopes, just as nails hold shingles in position on a roof Remove those nails and friction would be the only force that would hold them in place Start a few shingles at the top to sliding by a jar or pour water on them and the result would be an avalanche of shingles When the trees are removed and friction between the crust of snow and the soil is reduced you have an avalanche of snow

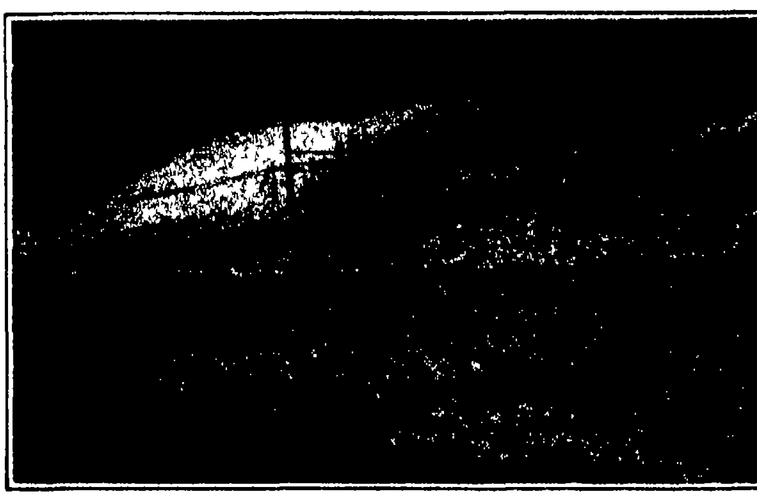
When a heavy mantle of snow has become charged with water on steep treeless slopes a snowslide may be expected to occur at any time The rain aside from adding more weight to the snow causes it to become more mobile Also the water seeping through the porous snow acts as a lubricant on the more impervious soil and causes a slipping plane Then something lends an impetus and aided by gravity the avalanche starts on its course of destruction

When conditions are just right any number of things may start the movement of snow Masses of snow losing their poise on precipitous rocky cliffs may give the necessary impetus A falling tree may cause a slide The vibration of a passing train, no doubt causes many In Switzerland it has been noted that the detonation from a gun has been sufficient to start a slide A small stone or lump of snow may fall from its perch and start rolling down the slope, increasing in size as it picks up more snow at every revolution until in one of its great bounding leaps it crashes down and with its momentum and added weight, pushes everything before it

There are two types of snowslides those confined to narrow canyons and those occurring on broad slopes. The former is by far the more destructive and once a slide has occurred in a canyon slides will continue to occur there because the first slide takes all debris that under less favorable conditions would offer obstacles to the phenomenon After the first slide the canyon becomes a veritable chute for future slides Railroads protect themselves from such slides by constructing snowsheds over their tracks, the train passing under the protection of the shed and the avalanche passing over the roof on down through its course The cost of such protection is exceedingly high

The location of a new canyon slide cannot always be predicted and it is the first slide which is the most difficult to clear away because in it the snow is mixed with stumps, trees, boulders and other debris which make the mass almost impossible to cut through

A year ago such a slide occurred on one of the transcontinental lines and shut off traffic on that road for a week This slide covered the track to a depth of more than 50 feet, and because of the tangled mass of debris it had to be blasted through As the snow melted later in the year the logs left as residue resembled a mill log pond In the spring of 1922 fourteen slides were counted in a distance of seven miles eleven of which reached the tracks and covered them to a depth of from 6 to 50 feet



A slope slide that covered the tracks for half a mile

Slope slides are less difficult to clear away because they travel a shorter distance and consequently are not so deep or carry as much debris These are less dangerous than the canyon slides, but because they cover wide areas and do not have well defined paths or occur the same place every year they cannot be economically overcome with snow shed protection

The remedy for both classes of slides is the "ounce of prevention" Forest fires burn up the trees—the pegs—that hold the mantle of snow in place while the spring sun gradually melts it down Careful selection of trees to be cut on steep slopes being logged is important to insure sufficient trees remaining to hold the snow

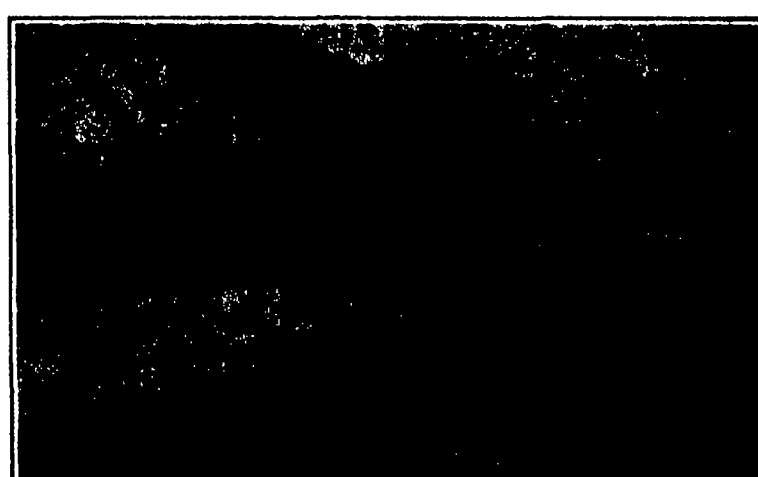
Once a steep mountain slope has become denuded of tree growth the cure for snowslides is expensive because recovery is slow The areas must be planted to trees and perhaps in places replanted several times, for slides may occur in places before those trees are 15 years old—old enough to hold back the snow

The snowshed is a protection measure against canyon slides, but not a cure As the paths of those slides become better scoured the slides become more frequent The paths of those slides are often a mile long To establish tree growth on such places the work must be started at the top planting a little every ten years or so until the bottom has been reached The principle involved here is that sufficient trees of sufficient size must be established above to hold the snow from sliding on the next strip to be planted below

Next spring if your train is late stop and think It may be battling with a slide This summer when you tour the forests look long at those big black burned over hills then enjoy the green ones—and *be sure you put your campfire out*

Is Snowfall Decreasing?

A RECENT number of the *Monthly Weather Review*, published by the U S Department of Agriculture, contains an article entitled "Are we having less snow fall?" by Mr C J Root of the Weather Bureau at Springfield Ill Snowfall in the State of Illinois is chiefly considered, but for completeness the author has discussed what has happened in other States. The inquiry is suggested by such remarks, as 'We do not have the big snows that we did when I was a boy and I do not think we will ever have them again ' At Springfield the snowfall has been rather light during several recent winters, although the greatest fall on record 43 inches occurred in the winter of 1913 14 The winter totals averaged for periods of ten years from 1884 are 20.3 19 6 21 9 and 20.3 inches In New England the snowfall was unusually heavy in the winter of 1922 23 at Portland the January fall was 53 inches and in the winter the total exceeded ten feet All highways are said to have been absolutely impassable for automobiles from the first week in January until the last week in March At Albany and New York the snowiest winter occurred some 30 years ago while at New Haven with a record from 1873 the heaviest snow occurred in the winter of 1915 16 and in 1922 23 the total was 10 inches above the normal Many more facts are given and the author sums up with the conclusion that in years to come the snowfall will be as heavy as in the past



Snowshed protecting a railroad. The track under the shed, which is entirely out of sight in this view, would be covered with snow if it were exposed; in fact, it is as clear as the one in the open foreground

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

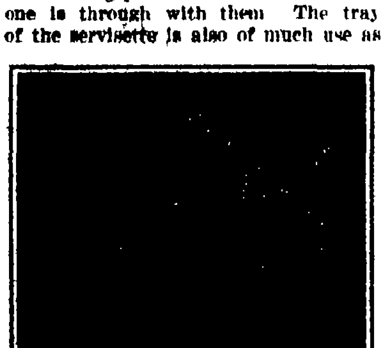
Padlock that uses a combination in place of a key

The Keyless Padlock

THE application to the automobile steering wheel which we illustrate is but one of the fields in which the keyless padlock invented by S B Sklar of Memphis, is available It has the external form of the ordinary padlock, save that the clevis enters a cylinder instead of a flat member as in the usual case This cylinder is built up of six disks each turning upon their common central axis and each carrying numbers from 0 to 9 around its edge When the disks are spun to set up the proper combination, the clevis is released and may be withdrawn The user according to the inventor's theory is less likely to forget the combination than to lose the key besides the physical inconvenience of carrying the key is eliminated

Something New for Setting the Table

ACCOMMODATING the four pieces of silver most freely used at table—knife fork spoon and teaspoon—the contrivance illustrated herewith is offered as a means of speeding up and systematizing the setting of the table as well as giving the finished set a neater appearance than it ordinarily presents The metal tray is three inches wide by four long With the wire rack erect in position to receive its load of eating tools, the height is 2¼ inches but the rack is detachable and may be laid flat upon the tray, thus minimizing the storage space taken up by the outfit between meals. In addition to the four pieces mentioned, the "servisette" will in a pinch accommodate several other items—butter spreader salad fork, etc It affords a place other than the plate and the table cloth whereon to lay these tools during pauses in their use or when one is through with them The tray of the servisette is also of much use as a place to deposit fruit seeds pits peelings, nutshells, cigar ashes etc etc We must confess to having more than once been embarrassed by the absence of a place to put such refuse When we were younger we used to hide it under the table on the little ledge in which the extension runner slides but in manhood's estate we have felt constrained to abandon this system and the servisette would be a welcome substitute



Sharpening the knife on both sides

Soft Drinks While You Wait

SOMETHING quite novel in the way of liquid refreshment for the weary traveler is offered, in the paper cup assembly illustrated The two cups are originally purchased, nested together as shown in the center figure of our photograph, and in the bottom of the outer member of this assembly beneath the packing of tissue paper which holds it in is a quantity of powdered flavoring One takes the cups apart from one another, fills the empty one with cold water and pours this back and forth several times to mix it with the flavoring matter One then has a perfectly good cold drink of whatever flavor one has originally selected—the outer container being plainly marked to identify this For use on trains automobiles boats etc, this system has obvious advantages over one that involves the carrying of soft drinks in fluid form

A Novel Knife Sharpener

THIS device is designed to sharpen or grind knives or cutlery and may be operated either by hand or motor power It consists of a cradle adjustable for both length and width of the blade, on which is mounted a vise the knife being held therein by a set screw On opposite sides of the cradle abrasive wheels are placed As the cradle moves

Cutlery tray that adds to the unity of the set table

in one direction one side of the blade is brought in contact with the abrasive surface A reverse movement of the cradle brings the other edge of the knife against the revolving abrasive wheel By means of such rocking and reciprocating motions a cutting edge is quickly and automatically given to the full length of the cutting surface

Dispersing Rubber in Water

ANOTHER epoch making invention has just been announced, the discoverer being a rubber technologist Mr William B Pratt, and, strange to say the first knowledge of it came from the disclosure in an Italian patent The process is extremely simple and consists in kneading crude rubber in water in the presence of soap bark with glue as an assisting agent As is well known pure unvulcanized rubber can be rendered viscous by benzole or other similar solvent so that it can be used for coating or cementing Such solvents are very inflammable and have resulted in many explosions and fires Furthermore the solvent is also lost Benzol poisoning is such a menace that the National Safety Council appointed a special committee to examine the evidence and the bibliography on the subject alone occupies seven pages of their report Attempts have been made to reduce the danger by working in closed cabinets where there is a surplus of air the volume of which is so great that all danger of explosion or fire is eliminated This plan however does not make for economical production It is for this reason that a water solvent is interesting to rubber manufacturers

Soft drinks in package form—add cold water and serve

The equipment required is only an ordinary dough mixer which can be set almost anywhere in the plant and as there is no danger of fire it can be set running and left alone The rubber in its crude form either 'pale crêpe' or smoked sheet, is introduced into a mixing mill and the power is started The rubber soon becomes warm when about 5 per cent of glue is added in either dry form as a paste made by heating the glue with a small quantity of water Up to this point we have a rubber glue mixture thoroughly incorporated The mass is now transferred to a suitable mixer like a two-blade dough mixer About 10 per cent of water is added and the mixer is started and is kept in operation until all the water is absorbed. A heated solution of saponin (soap bark) is added slowly and the entire mass is gradually diluted with hot water The mixing is continued until a smooth paste is produced in which the rubber has been dispersed into small globules Rubber compounds such as fillers, etc may be treated in the same way The dispersed rubber may be vulcanized if desired the process not impairing any of the possibilities of vulcanization

The dispersed rubber can be spread upon fabrics and the cloth used for the manufacture of hose raincoats tires vehicle tops etc It can be used in the place of volatile solvents for cements for special vulcanized paper, in the production of artificial leather in tree surgery, as a binder for building and flooring materials and last but not least in chewing gum manufacture Further experiments will probably develop new fields of usefulness so in a short time we have had two radical additions to the technology of rubber 'latex' and "dispersed rubbers."

Phonograph attachment that enables the deaf to use this instrument

The Deaf Man's Phonograph

WITH the aid of the dentiphone invented by J W Gonce of Anderson Tenn the pleasures of the phonograph are extended to the hard of hearing The picture is largely self explanatory as it indicates one end of the attachment carries the stylus which rests in the groove of the phonograph record while the other is formed into a mouthpiece to be held between the user's teeth The tones of the record then become audible to him through the vibrations of the bones of the head which are set up—quite as many deaf people are enabled to hear ordinary conversation through an instrument that brings about such vibration

Mr Gonce tells us that the device may be constructed from any suitable resonant material such as steel hard rubber or numerous woods While a stylus or needle of metal is desirable favorable results have been obtained with stylii of hard wood The inventor does not confine himself to the form or cross section illustrated There must of course be a head of some sort to carry the stylus and at the other end a suitable mouth piece and near each end there must be a thin flexible section—the one near the stylus helps the latter to follow the groove in the record while the one near the mouth piece is necessary to avoid shock and jar to the teeth Between the two thin sections the instrument may be of practically any cross sectional figure whatever

The White Stripe on the Road-Center

FOR painting a white stripe down the middle of the concrete highways in Wayne County Michigan a pneumatic spray painting machine has been devised

Marking the center of a Michigan highway

Steam-coil heater that multiplies by five the efficiency of the ordinary outfit of the sort

which is most practical in operation and has reduced the cost of this work materially. Under the old method four painters could stencil about one mile a day. With this machine two men can cover six to seven miles per day.

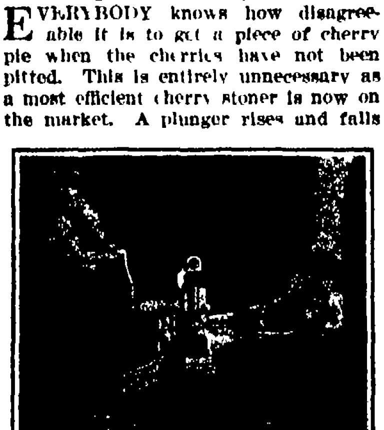
The equipment consists of a compressed air paint spraying machine that is mounted on skids and is bolted to the floor of a truck. A wooden wheel two feet in diameter, four inches wide and covered with a strip of felt one inch thick revolves on an axle that is part of an iron frame attached to the rear of the truck. The wheel is so placed that it follows in the track of the left hand wheels of the truck. As the truck is driven ahead the paint is sprayed directly on to the felt and as the wheel trails after the truck the paint is immediately transferred to the pavement. Chalking the middle of the highway helps the driver in centering the stripe.

A Guard for the Button Polisher

OUR buttons do not need to be cleaned as a usual thing but if you wore a uniform bearing brass buttons, it would be different. And the uniform is very apt to be soiled during the cleaning operation. This is obviated by an inventor's clever device by which the button is held away from the cloth by a tin shield so that the cleaning material may be applied to the button without any danger of getting on the cloth. The holder is adjustable to any size of button. And if it is desired to polish the button, it can be done with what is known as the "polishing mit" which consists of a number of pieces of chamois attached to a back. This affords a useful chamois cleaner.

Stoning Cherries by Machine

EVERYBODY knows how disagreeable it is to get a piece of cherry pie when the cherries have not been pitted. This is entirely unnecessary as a most efficient cherry stoner is now on the market. A plunger rises and falls and cuts the cherry so that the stone is forced out. This is interesting to bakers and restaurants and would be very useful in the kitchen of the average house or apartment.



Getting all the stones out of all the cherries, by machine

Steam Heat Without Radiator Troubles

MUCH the same constructional principle as that of the "copper-cooled car" is seen in the heater unit illustrated herewith. The steam coils in this heater are of copper and brass to begin with both offering far less resistance to the transmission of heat than does iron. And on top of this, these tubes are of straight, seamless copper and brass tubing while around them is helically wound a copper ribbon in such fashion as to form a continuous fin. This fin is not actually welded to the tube as the copper fins of the "copper-cooled" car are to the iron cylinder casting but it is bent in such a way that a large surface of the fin is in contact with the outer surface of the tube, and this union is brazed. This insures easy passage of heat from the tube to the fin and from the fin to the air that passes through the heater. The heater unit itself, shown externally in our picture, is mounted at strategic points in large or small rooms, throughout factory and warehouse buildings, etc. The fan has a capacity of approximately 3000 feet of air per minute and this air issues from the unit thoroughly heated.

An Experience Machine for Elevator Interlocks

THAT "experience is the best teacher" has been a proverb from time immemorial. Unfortunately it takes time, often long periods of time to gain experience that is of real value. One of the greatest drawbacks in the rapid development of mechanical devices is the length of time necessary to determine its merits or short-comings. Automobile manufacturers test new engine types and

Polishing the button without soiling the uniform

other automotive innovations for months or even years before the device is placed on the market. Sometimes machines in charge of picked crews are run day and night over rough roads in order to expedite the task of obtaining this needed experience.

When the City of Baltimore recently revised its elevator code it took a step forward by requiring all hoistway door interlocks to pass rigid engineering tests before being approved. Arrangements were made with the U. S. Bureau of Standards to conduct these tests.

As a safety device of this kind should provide several years of trouble-proof service it was desirable to obtain the same wear that would normally develop during a period of years within as short a space of time as possible. At the same time it was obviously undesirable to operate the device faster than it would be operated in regular service.

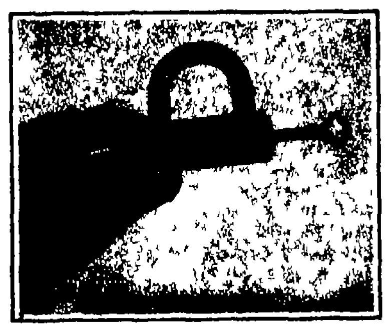
After a considerable study of the various factors involved a machine was developed and put in operation which duplicates the performance of the elevator operator, and in addition tests the door and car control when they are presumably locked. Failures are recorded both electrically and on a mechanical counter.

By an ingenious arrangement of parts it is possible to run two tests simultaneously one in an enclosed hoistway (dust test or corrosion test) and one in the open hoistway (life function or lack of lubricant).

In addition to operating the hoistway door and the car controller it was necessary to devise mechanisms which would operate foot pedals, lift latches, pull down on bar lock handles and give the same sweeping pull on the handle of door closer type devices that the operator would. These and similar engineering problems were successfully met and the machine can take care of practically any type of device on the market.

The testing machine is also arranged so that the range of movement of both platform and hoistway door through which a given device will operate can be accurately ascertained.

The City of Baltimore has already published a list of seven devices which have met these tests.



The padlock that thrives on rough treatment

Auditory Masking of Pure-Tones

USING an air damped telephone receiver supplied with current with a proper combination of two frequencies, as source the amount of masking by tones of frequency 200 to 3500 was determined by R. L. Wegel and C. E. Lane for frequencies from 150 to 5000 per second. The magnitude of a tone is taken as the logarithm of the ratio of its pressure to the threshold value, and masking is taken as the logarithm of its threshold value with masking to that without. The curves of masking as function of magnitude are approximated straight lines as a rule except for rounded feet, of slope s intersecting the magnitude axis at minimum masking magnitude m. For a given masking frequency n the slope increases from zero through nearly 1.0 for a frequency near n, then more slowly, approaching about 3 to 4 for the highest frequencies measured. The intercept is small or zero below n, then increases rapidly, approaching the value 8 for the higher frequencies.

Except when the frequencies are so close together as to produce beats, the masking is greatest for tones nearly alike. When the masking tone is loud it masks tones of higher frequency better than those of frequency lower than itself. When the masking tone is weak, there is little difference. If the masking tone is introduced into the opposite ear, no appreciable masking occurs until the intensity is sufficient to reach the listening ear through the bones of the head. At intensities considerably above minimum audibility, there is no longer a linear relation between the sound pressure and the response of the ear. Data are given showing combinational tones resulting from this non-linearity when two tones are simultaneously introduced in the same ear.

The presence also of subjective overtones in a loud tone accounts for the large amount of masking of tones higher than itself which is observed in the case of a loud masking tone.

The data on masking together with Knudson's data on frequency sensibility are interpreted in terms of the dynamical theory of the cochlea which ascribes its frequency selectivity to passing of vibrations along the basilar membrane and a shunting through narrow regions of the membrane at points depending on the frequency. Conjectured curves are given for a few single frequencies of the amplitude of vibration of this membrane as a function of the distance along it.

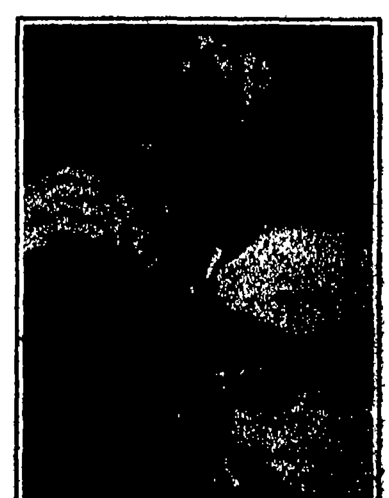
Bean-stringer that works much like the carpenter's plane

A Different Padlock

THE special construction of this padlock makes it particularly theft proof. A patented bolt is used to lock securely together the two solid pieces of steel which make up the lock. This bolt is inserted in the steel casing of the lock and it is claimed that it cannot be picked or broken. The lock can be left open by turning the shackle around and inserting the bolt through the end remaining in the casing.

Cutting and Stringing Beans

EVIDENTLY no inventor has ever devised a machine which will take out the strings and cut the beans into proper lengths at the same time. But the two devices which we show for doing these things separately are very simple. In a stringer a knife like a plane iron is set in an iron frame and the bean is drawn over the knife. The objectionable portion of the bean namely, the string, is eliminated. The cutter consists of a disk having knives which cut the beans into proper lengths as they are forced through the channels in the casing. The speed of this machine is very great, thus making it very valuable in restaurants and hotels.



Companion piece to the bean stringer shown above, cutting the beans into uniform lengths

The newest thing in kindling material, fresh from France

Kindling Fires with Sawdust Cake

THE curiously figured cakes seen in the photograph at the upper left corner of the page are not the latest health food from Battle Creek, but rather a Scotch fire-lighter—at least, their trade name is Scotch fire-lighter, though they are made and used in France and imported to this country only from France. They are of a sawdust conglomerate, held together with some unidentified binder. They serve the purpose to which yesterday's newspaper is ordinarily put in this country—kindling the wood that is to kindle the coal. Though easily crumbled and broken into smaller pieces as our picture indicates, the importer assures us that the lighters are designed to be used whole. They are set up on edge, several in a row, and the wood laid across them. They will take fire at any point on their surface, from a match, and will burn vigorously for a considerably longer period than ordinary paper kindling—though not long enough to ignite wet wood. The fancy hole in the center of the lighter cake is for the purpose of introducing air to promote combustion.

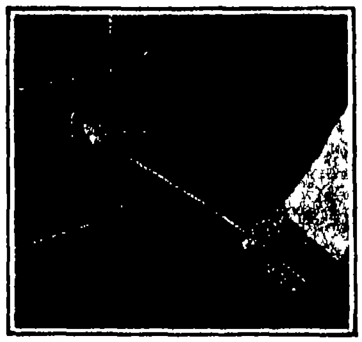
Gaging Work While It Is Being Ground

SO that work will not need to be stopped for the use of a snap gage or micrometer, a grinding gage has been developed which measures work while it is being ground. The gage consists of a body in which a plunger and a plunger spring are housed and on which the indicator is mounted. Each gage contains three diamonds, two of which are mounted in the ends of adjustable screws and one is mounted in the end of an automatic spring-actuated stylus or plunger. A spring pressure of less than one ounce will keep the diamond points in contact with the surface being ground, penetrating the grinding fluid and giving true measurements. While the grinding proceeds the dial of the gage gives visible readings of the diameter.

Gaging on the fly, without stopping the machine

That Hermetically Sealed Window

A FRAIL old lady vainly wrestling with a Pullman car window in an attempt to open it. A genial Tarzan of a man confidently offering to open it for her. One genial Tarzan of a man, now redfaced and puffing embarrassedly retreating after having completely disarranged the ready bedding of a very particular old lady, without having budged the sticky window one umpteenth of an inch. The fact is, according to *Pullman News*, a special organ of the Pullman Company, the windows of Pullman cars are purposely made hard to open in order to cut down to the minimum all chances for drafts and dust. This, says that periodical, is why passengers sometimes say naughty words when they essay the task, rather than call the porter. But the Pullman cars are now being equipped with a special device consisting of a lever with a sliding hinged fulcrum. By means of this lever the most obstinate window can be started without the necessity of crawling into the berth or even of working one's self into a fit of anger.



A sure-fire opener for jammed railway-car windows

A New Technique in Making Hash

WE are not apt to associate hash with France but the latest improved chopping bowl comes from that country. It consists of a wooden bowl with a knife of the same curvature as the bowl. Before chopping, the food is cut in small pieces and the knife may be used for this purpose. When you wish to do fine chopping, the blade is pressed slowly on the bottom and in the center of the bowl. The wrist is then moved to and fro so that the blade describes part of a circle. After each motion, the wooden bowl is slowly turned. The hachinette is extremely valuable in mincing vegetables.

A Roller Skate That Works Like an Ice Skate

THOSE of us whose memories carry us as far back as the last two or three years of the nineteenth century will perhaps remember the bicycle-skate, and the craze which accompanied its introduction and lasted for some months. For those of us who don't remember it, it may be explained as a roller skate with two rubber-tired wheels, mounted in tandem one behind the other, centrally beneath the foot. It gave a thrill which the older, four wheeled skate never possessed, but for some reason it never really caught on.

A fresh attempt is now being made to put the roller skate upon a new basis. This time we are offered a skate with three wheels, but they are mounted all in line, and not in tricycle fashion as one might infer from a mere statement of their number. The inventor is Mr. M. Metcalf, of London. The real trick to these skates is found in the central wheel. This is a trifle larger than the other two, lending the arc effect of the ordinary ice-skate blade. The skate is very light—15 ounces for the gentleman's model and 12½ ounces for the lady's.

Color Photographs of Microscopic Plants

THAT color photographs of microscopic plants can be taken by the light emitted by the plants themselves after stimulation by a strong beam of light was shown before the American Association for the Advancement of Science on December 29 by Professor Francis E. Lloyd of McGill University.

Plants contain a considerable number of pigments which have the property of fluorescence, a property due to the ability of the pigment to change the wave length of the blue-white part of the spectrum into the longer wave lengths green, orange and red. In the case of green pigments, the result of this property is to produce red light even though no red light is supplied.

The attempt has often been made by various workers to see fluorescence in living microscopic plants by means of the microscope, making use of a special optical arrangement known as the dark field illuminator. The lack of success following these attempts led to the conclusion that this was not possible. Indeed, the only way in which fluorescence has been seen microscopically in the living organism is by means of a very special optical arrangement known as the fluorescence microscope or one in which only ultra-violet light is permitted as an illuminant. Since the visibility is low, no structures can be seen nor can high magnification be successfully used.

Professor Lloyd described a method of his own invention whereby the dark field illuminator can be so adjusted as to project a strong beam of light upon microscopic organisms in such a way as to bring out a brilliant fluorescence and also reveal their structure. When viewed by this method microscopic plants were seen to glow in brilliant hues of red, orange or yellow. Preparations of living plants were exhibited in which this was visible to the audience. Color photographs were also shown.

The hash-knife that fits the curve of the bowl

The importance of this discovery lies in the fact that it affords a new method of studying in plants the pigments which are connected with the process of photosynthesis, or the building up of tissue from the carbon, hydrogen and oxygen of air and water through the action of light. Evidence is increasing that other pigments beside the green chlorophyll are of importance in this way. Already structural relations have been demonstrated which were previously not understood.—*Abstract from Science for January 4, 1924.*

The roller skate that runs like an ice skate

An Ingenious Wire-Tying Machine

A WIRE tied box is about twice as strong as the ordinary nailed box if the wires are properly applied. Such boxes, when used for the shipment of merchandise are greatly protected against pilferage simply because pilferers prefer to attack the comparatively unprotected package rather than one on which a tied wire has been broken and which is readily detected while in transit, fixing the liability on the carrier in whose hands it happens to be. Further a wire-tied package permits equal strength with less thickness of lumber.

The new wire tying machine which is illustrated on this page is for tying wire on the package, not for making hoops to be placed around it later. It does not think but the observation of this device in action calls to mind a pair of extremely powerful human hands directed by a brain making taut loops around packing boxes, cutting the wire after twisting it into a good solid joint and going on to do the same with the other end of the box.

This machine has two levers, the inner ends of which show clearly in the accompanying illustration, one extending to left, the other having a bifurcated inner end, extending upward. These levers do the work, in company with a good pair of biceps. As shown here the job has been finished and the device is ready to begin the next tie which will go something like this. The machine will be placed on the box and the wire formed with a head at one end so that it may be hooked under the little latch visible at extreme lower right. Then it goes through the gear and the hollow circular cutter which latter does not however cut until the tie is finished. The free end encircles the box and comes back alongside the fixed end, continuing to the tension winch at the left.

The left hand lever is worked until the wire is tautened and then locked. Now the twisting is done by means of the other lever (whose handle has, like that of the first lever, been sacrificed

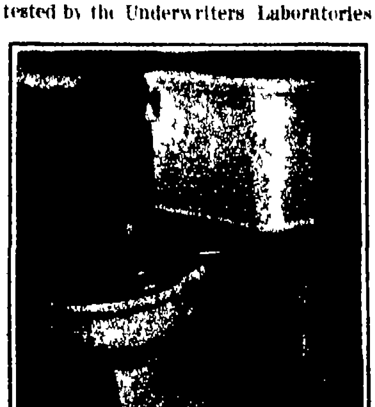
Machine for wire-tying small and large packages

Flash-light gun with large advantages over the more familiar model

to the practical eye of the space jealous editor as being taken for granted). Finally the wire is automatically cut and when the handle is brought smartly to full back position two round push rods faintly visible behind the twisted joint pop out and eject the whole wire. The tie is finished.

A Fence You Can't Drive Through

MANY highway accidents to motorists are a result of going over cliffs and bridge-sides. Roads that skirt along the faces of very steep hills or that run along the tops of cliffs are generally protected by means of wooden guards. In many of these cases the protection is largely psychological. One feels safe as long as the edge of the road has a barrier. Even if the barrier is a light fence of wood there is that same misleading feeling of security. Take away the frail fence and one would drive very gingerly in the same place. Yet in many places of this sort there is for all practical purposes no guard rail at all; a moving car would crash through as easily as a dog jumps through a paper ring in a circus. One remedy is heavy masonry or concrete, but this is expensive. Moreover when the errant car connects it generally comes out second best—and decidedly second hand. But a Bridgeport, Conn., manufacturer has found a way around the difficulty, and a way to keep the wobbling car on the right of way without battering its face too severely. This is a specially fabricated wire material which, owing to its mesh design, is highly elastic. Instead of attempting to bring the moving car up instantly, which cannot be done, it brings it up slowly. This fence has been tested by the Underwriters Laboratories. It was stretched between two regulation posts, using ordinary 1¼-inch staples for attachment. Then, to simulate the blow struck by a car, a 650-pound weight suspended from a 68-foot line was drawn back 30 feet and released, swinging like a pendulum against the fence. The fence absorbed the blow like a Jack Dempsey and came back for more. Now, since the mathematical editor assures us that S equals $\frac{1}{2}GT^2$, we know that this blow was equivalent to that struck by a 3000-pound car moving at twenty miles per hour. The Underwriters gave it their "O K" and we next hear that the Ohio State Commission has ordered a section of it installed at a famous "Death Curve" near Columbus. Such material as this would doubtless serve equally well to give the "Stop and come-back" command to those aspirants after sudden death who insist on rushing the gates at railway crossings and driving upon the tracks just as the train comes along.



Suction blower installed on a standard toilet-bowl

A New Flashlight Gun

A NEW device for the igniting of photographic flashlight powder is the subject of a recently granted United States patent, 1 480 162, to B. Crotta. This gun is unique in that it utilizes for the ignition unit an electrically operated match head such as are employed in large numbers in the setting off of commercial electric detonators. The device, as shown in the accompanying photograph, is made of a single piece of cast aluminum which is provided with suitable clips for holding the match head and with means of making electrical

A guard rail that really guards for the steep bank and grade crossing

contact. The handle is hollow and contains a standard flashlight 2 cell battery which supplies sufficient electrical energy for several thousand match heads. Contact may be made either with a conveniently located push button switch or extension wires may be plugged into a suitable receptacle and contact made by means of a push button switch attached to the other ends of these wires. The plug closing the lower end of the hollow handle bears a standard tripod socket which permits the gun's being mounted on a tripod.

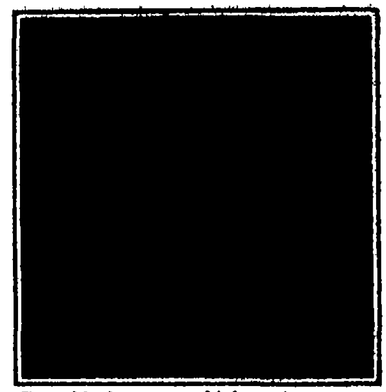
Among the advantages claimed for this gun are instantaneous action, compactness, reliability, capability of being operated from any desired distance so that the operator may be "in the picture" himself, capability of firing several guns simultaneously by closing one switch, and low cost and ease of operation.

The Ventilated Toilet-Bowl

BY means of an electrical contact which is in effect only while the seat is occupied, a Kansas firm provides means for removing all objectionable odors from the bathroom. The apparatus embodies a suction fan, capable of removing something like eighty cubic feet of air per minute from the toilet bowl. The air thus removed is carried outdoors by means of tubing and is of course automatically replaced by clean air from indoors. The device is of convenient size, easily installed, and finished to harmonize with its surroundings.

A Loom in a Hand Satchel

EARLY typewriters afford no greater contrast against the ultra modern portable machine than do early looms against the portable loom invented by Mrs. A. N. Shook of New York. This loom folds up like a campchair, fits into a carrying case, and is carried about from place to place with the utmost ease. It weaves all kinds of fabrics, from silk to heavy wool. It is designed for use in schools, and by women who like to do hand weaving to earn money in their spare time or to satisfy their desire for seeing designs of their own production turned into cloth.



Portable loom on which real weaving can be done

Direction of Ejection of Photo-Electrons by Polarized X-Rays

STEREOSCOPIC photographs were obtained by Frank W. Bubb using Wilson's cloud expansion method, which show the ionized tracks of photo-electrons ejected by plane-polarized X-rays. The polarized X rays scattered by a paraffin block at 90 degrees to an unpolarized primary beam of hard X rays were directed horizontally through the expansion chamber of a Wilson cloud apparatus in which they produced the photo-electrons. Exploded tungsten wires furnished the instantaneous illumination of the droplets. The photographs, taken with the plate at 90 degrees to the polarized beam, show two types of asymmetry in the direction of ejection of the photo-electrons. Latterly there is a strong concentration of photo-electrons ejected nearly in the direction of the electric vector of the plane-polarized radiation performing the ejection. Longitudinally stereoscopic examination of the photographs shows one sixth of the photo-electrons ejected with a component opposite to the beam, one-third ejected approximately at right angles to the beam, and one-half ejected with a component along the beam. As regards theoretical interpretation according to the classical and quantum theories, the results are in accord with the classical theory. To explain them on the quantum theory we must assume that the quantum is a vector bundle of energy, for it explodes, so to speak, at right angles to its direction of motion.

On the Scattering of X-Rays by Hydrogen

IN a paper under the above title in the *Physical Review* for February by G. A. Schott, measurements of the absorption and scattering of X-rays by hydrocarbon compounds made recently by Aurén, by Hewlett, and by Olsen, Dershem and Storch, are considered critically insofar as they serve for the calculation of the mass-scattering coefficient of hydrogen for different wave-lengths and its comparison with the results computed on the basis of (1) the simple pulse theory, (2) the electron ring theory, (3) the ring-electron theory and (4) the quantum theory of scattering recently proposed by A. H. Compton. It is found that none of these theories, even when it is interpreted in the widest sense, agrees with the experimental results over the whole range of wave lengths. This failure may very well be due to the inaccuracy in the experimental results since the method of calculating the mass-scattering coefficient from measurements made upon compounds necessarily magnifies the experimental errors very considerably owing to the smallness of the scattering of hydrogen as compared with that of the remaining constituents. The importance of obtaining reliable data is pointed out and it is suggested that sufficiently accurate results can be secured only by using the element in the free state.

The Drying Tree

WHEN the very obvious object of the adjoining picture was brought into our office and set down before our startled eyes it didn't have any towels hanging upon its arms to identify its purpose, and opinion was divided among certain members of the staff as to whether it was a new fangled hat-rack or a synthetic Christmas tree. The parties to this argument, however, were all single; the instant one of our Benedicts got his eyes upon it he identified it for the drying rack which it is, and demanded to know where he could buy one like it. Very plainly it provides a lot more drying space than the usual rack of more or less similar design, and very plainly, when it isn't drying anything, it folds up into marvelously small compass.

Domestic drying rack of unusual compactness and capacity

Ingenious tackle that adds to the safety of the man who works on the face of tall buildings

Sure-Fire Safety for the Human Fly

SAFETY for the worker whose job lies somewhere between the sidewalk and the roof of a tall building—safety for him of a degree never previously approached—is the aim of the tackle illustrated herewith, which has been tried out recently in Paris with great success. The cable is rigged to a secure mooring on the roof and threaded through the framework of the basket in which the workman is to travel. A fool-proof handle control shown above the workman's knees in our photograph makes it possible to grip this cable at the point indicated, in a fashion which absolutely insures the safety of the man in the basket.

A Turf Cultivator

AN Ohio man has invented a cultivator for lawns and golf course greens that incorporates several features of unusual worth. The machine is designed for use on hard ground where grass either grows in small quantities or does not exist at all. Its purpose is to cultivate turf of all kinds without destroying it, but rather to make it more luxurious and thrifty.

The feature of the cultivator is the arrangement of the ten disks that make a total of 48 incisions, 2 inches long and 2 inches deep, to the square foot at one cultivation. The disks are 1½ inches apart on the shaft, which is 15 inches wide.

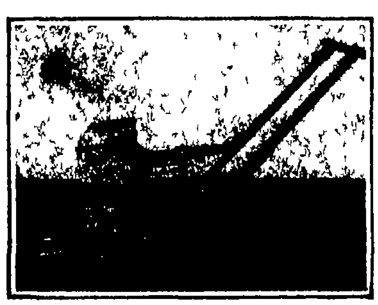
The cultivator has been constructed so that the cutting blades in the form of teeth, operating to a depth of two inches, cut the surface of a hardened turf into blocks, 1½ inches square, allowing these incisions to be separated by sand or fine organic matter so that the surface can never again become hard and compact. Penetration is effective without creating permanent punctures, due to lateral pressure as would be caused by driving spikes into the soil. As the cutting teeth of this cultivator come from the soil they are lifted directly from the incision, thereby leaving the surface intact.

The machine in operation permits the incorporation in the top two inches of soil of 10 cubic inches to the square foot of material such as sand, seed or organic matter at one cultivation or operation. Cross-cultivation increases the number of incisions and doubles the quantity of material available for the lawn or other turf. Persistent cultivation with this machine adds materially to the softness of the lawn or turf.

The machine is equipped with a box for the holding of seed, sand, organic matter or lime, as required. A distributing device attached to the machine makes possible the filling of the incisions at the time of cultivation. This has been proven the only device, the inventor claims, that will create proper turf conditions with the minimum amount of labor on lawns or golf courses.

The supply box holds fifty pounds of organic matter. The bottom slots correspond to the disks on the machine and two agitators stir the material, forcing it through the slots into the incisions made by the disk teeth. A carrier for added weight is included in the machine, making it possible to cultivate the turf to almost any depth. However, if the turf is properly watered but little added weight is required.

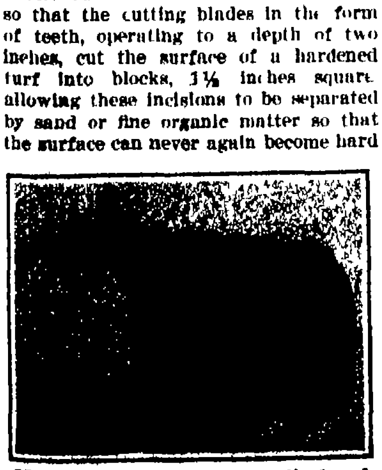
The machine makes it possible to seed a turf at the time of cultivation by mixing the desired amount of seed with the other matter being used. The germinated seed at once develops a two-inch rootage and is insured a constant supply of moisture through the porosity of the material filling each incision. Used at intervals of two weeks, it is claimed, from four to five tons of organic matter may be applied to a surface of about 7000 square feet, insuring the porosity and sponginess necessary for a deep-rooted turf as in the case of a golf green where perfect playing conditions are almost a necessity.



A turf-cultivator for lawns and golf greens

In the case of use on a golf green play is not stopped during the operation of cultivation. Incisions not filled with organic matter or other material immediately close upon watering, thus doing away with the use of a roller. To insure perfect working conditions of the machine turf to be cultivated should be thoroughly wetted before the cultivator is used. It is also claimed that the machine represents the only method by which lime may be deeply and properly applied to blue grass turf or golf greens.

The machine operates at the speed of an ordinary lawn mower and is easily drawn by two men.



Motor-driven sled recently displayed on the Quebec ice

Winter Sports a la Airplane

THE development of the airplane is responsible for a number of devices for making use of screw propulsion without leaving the ground, and of all these, none is more efficient than one in which this type of power plant is mounted on a sled of some sort. We illustrate an obviously home-assembled outfit which was recently seen on the ice at Quebec. An ordinary automobile engine and the remains of a closed car body have been combined with a perfectly regular airplane propeller and a set of light runners of, apparently, nondescript origin—and there you are! No data are offered regarding speed but the position of the exhaust pipe is a guarantee of sufficient noise to satisfy the most ardent motor sleighman.

A Small-Scale Shoveling Machine

THERE has always been a gap between the steam shovel and the spade, lots of jobs being too small to be handled by the one but too large for profitable prosecution with the other. A small digger for operation in connection with the ordinary farm tractor is now offered, which seems to fill this gap admirably.

The machine was designed primarily as a loader and in this connection it is used without teeth. With the truck or wagon set parallel to the machine the only movement required is to drive the tractor forward several feet, hoist the bucket, and back a few feet alongside the truck, when the boom can be swung over for dumping the load. The photograph shows the truck backed up against the outfit, for use in a slightly different fashion. The hoisting drum for the main cable can also be used as a contractor's hoist on small jobs while the bucket can be removed after taking out a single pin, putting the outfit in shape for use as a baby locomotive crane.

Bridging the gap between the spade and the steam shovel

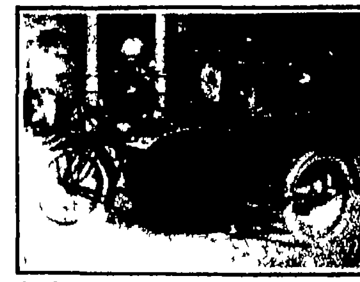
There are many places where this little loader can be used with effect. In the filling of concrete-mixer skips from stock piles, in work along the shoulders of roads, in snow clearing and in a variety of work done ordinarily by hand shovels it is available.

A Handy Gadget for the Magazine Subscriber

HOW do you remove the wrappers from tightly rolled newspapers or magazines? The usual attempt to tear the wrapper off is discouraging as the tight paper refuses to tear. Attempts to use a knife are similarly disappointing because of the danger of mutilating the contents of the wrapper.

The problem has been solved by a cutter devised by Arthur F. Hoffman, a rural mail carrier at Harvard, Neb., recently submitted to the Post Office Department and approved by the Postal authorities. This cutter is in the form of a knife with a curved and flattened tip. The flat point is easily inserted underneath the wrapper and a forward movement of the instrument results in clean cutting of the covering without damage to the contents.

The Post Office Department finds that the cutter may have value for rural carriers in cutting the twine with which packages of mail are fastened. Injury to the mail is considered practically impossible.



Cycle and side car taxi from the streets of Calcutta

The Side-Car Taxicab

THE jinriksha still prevails in Japan, and equally primitive ways of applying human leg power to the transportation of the upper crust of human society rule in other corners of Asia. But the taxicab and its cousins are to be found in surprisingly out of the way places and it looks as though the human beast of burden were up against tough competition. Something rather novel in the way of taxi service the photograph of which comes to us all the way from Calcutta is the immediate source of inspiration for these remarks. The thing is of the three-wheeler species, better known in the American tongue as motor cycle with side-car. But it is a most sumptuous and elaborate rig as our photograph indicates. The dark skinned person in charge we have no doubt is the aristocrat of his caste and looks down with condescension upon those of his brethren who still have to apply elbow grease and knee-power to the moving of their loads.

The Electrical Properties of Flames

THE capacity and equivalent series resistance of a condenser consisting of two concentric platinum cylinders, 0.5 cm apart in a flame containing K_2CO_3 vapor were measured by A. B. Bryan using a modification of the method of resistance variation. Values are obtained for voltages between 11.4 and 82.2 volts, for frequencies between 2×10^5 and 10^6 cycles per second and for salt concentrations up to 10 grams per liter of K_2CO_3 solution. The resistance is approximately independent of the field but decreases somewhat as frequency increases and also as concentration increases. The capacity is half as great for 82 as for 11 volts and for 10×10^5 as for 2×10^5 cycles but increases greatly as the concentration increases.

For opening tightly wrapped magazines without damage to the pages

The Heavens in June, 1924

The Fall of the Nebular Hypothesis, and the Rise of a Plausible Substitute

By Professor Henry Norris Russell, Ph D

AMONG the many hard questions which the layman often asks of the professional astronomer, one of the commonest is "How did the solar system get there?" But it is not the man in the street alone who asks this For a century or more, men of science have been putting this great question of our origin to themselves, to one another and to Nature herself—and though we would be far today from claiming that we know the full and complete answer we hope that we have some inkling at least, of its character

The first serious attempt at such an explanation was made, more than a century ago, by the great philosopher Kant, and put into physical form by the equally great astronomer, Laplace According to this well known "nebular hypothesis" *the solar system originally formed* a single rotating mass, which from age to age gradually cooled and shrunk, and was thus forced to rotate faster and faster Finally its rotation became so rapid that centrifugal force at the edge gained the upper hand, neutralizing the attraction of the mass, and part of the matter was ejected, forming a ring which later coalesced into a planet A succession of such events, it was assumed, led to the formation of the planetary system as we know it

This familiar theory has the great advantage of accounting for most of the main features of our system—the existence of many planets all moving in the same direction in nearly circular orbits in almost the same plane But attractive as it is, it breaks down disastrously in detail and makes complete shipwreck on the rock of angular momentum

Why Laplace's Theory Will Not Work

What this means we can see in a moment To find the "angular momentum of any planet in our system, we take its mass, its distance from the sun, and its speed in its orbit (or more precisely, the part of this speed which is at right angles to the radius joining the planet to the sun) and we multiply these three factors together Do this for each planet, and also for the rotating sun itself (taking *each part separately, and adding the results*) The sum, for all the planets and the sun, is the total angular momentum of the system (the rotations of the planets, and the motions of the satellites contribute too little to count) Now from the principles of mechanical science (discovered by Newton and firmly established by the works of innumerable investigators ever since), it follows that any action of one planet on another, or of the sun on *any or all, can only transfer this angular* momentum from one part of the system to another What one part loses, another part gains, and the total amount can be altered only by action proceeding from without the system

Now when the angular momentum of the solar system is calculated, it is found that more than 98 per cent of it resides in the orbital motions of the planets (mostly in Jupiter and Saturn) and less than 2 per cent in the rotation of the sun—and yet the planets all together, have only one-seventh of 1 per cent of the *mass of the system* *Any theory of the origin of the* system must account for the strange fact that so small a fraction of 1 per cent of the mass carries more than 98 per cent of the angular momentum, and no one has ever been able to devise any explanation how this could have resulted from internal forces, operating solely within the system It is not, of course impossible that some such explanation *might* be devised, but nothing of the sort has ever been done, and it can be proved that the theory of Laplace, in particular, is incapable of it

It appears, therefore to be very improbable indeed that our solar system has come into being by the action of internal forces. Rather must we look to some external force which, in the same action removed a small fraction of the sun's mass to form the planets and imparted to them their circulating motion and their present great angular momentum

Such a force may be found in the attraction of a passing star—provided that, at some remote period another star happened to pass very near the sun *What would happen then was first suggested by* Chamberlin and Moulton of Chicago and has since been worked out in mathematical detail by the Englishmen, Jeffreys and Jeans

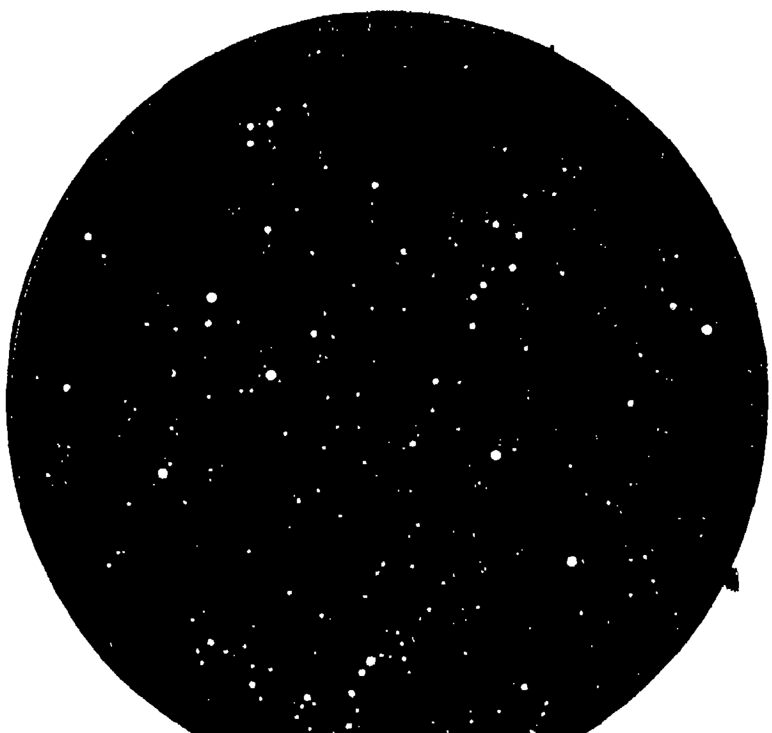
The Solar System Born by Chance

As the visiting star approached the sun, its action would raise tides in the fluid mass of the latter, which would become higher and higher as the intruder came nearer So long as the star did not come within three or four diameters of the sun, these tides, though rising *perhaps to heights of tens of thousands of miles*, would sink back again as the star departed on its way But if the star came too near, the solar tide would rise so high that it could not stop rising and when the star was nearest, part of the sun's substance would flow out from the regions of high tide—one facing the star and the other opposite it—and form long streams or filaments of gaseous material The attraction of the parts of this stream for one another would then cause it to break up crosswise into separate condensations (as a long thin stream of falling water breaks into separate drops) while the attraction of the passing star, still near by would pull these sideways and set them circulating about the sun.

After a few months or years the passing star would have receded so far that its influence ceased to be important The ejected matter would be left moving around near the sun—some to fall back into it, some perhaps to fly off into space, but much to remain circulating about the sun All the condensations would move around the sun in the same direction, and nearly in the same plane—that of the hyperbolic orbit of the visiting star As they settled down to orderly existence after the great catastrophe, we may see in them the *newly-born planets.*

Jeans has pointed out that such a filament of ejected matter would be likely to be thin at the ends and thicker in the middle—which fits in well with the fact that the greatest planets, Jupiter and Saturn, are near the middle of the series. These great planets must still be largely gaseous, and they are attended by extensive satellite systems—miniatures of the solar system, which Jeans attributes to eruptions from the new formed planetary masses, under the influence of some close approach, perhaps to the sun. For the earth and Neptune, each of which has a single relatively large satellite, Jeans thinks it likely that the mass soon became liquid, and then shed a relatively large portion of itself Venus and Mercury, which have no satellites may well have cooled down and become solid fast enough to prevent disruption.

The general outlines of the planetary system appear thus to be well accounted for, and we have the excellent authority of Jeans (from whose discussion much of the above is borrowed) for pronouncing this theory to be reasonably satisfactory *Jeffreys has shown*, in addition, that the collisions between the large condensations (the planets) and the small ones which doubtless also existed at first, would gradually operate to clean up the latter, and to make the orbits of the planets themselves rounder and rounder To reach their present nearly circular orbits, he figures, probably took several billions of years This estimate agrees very well with those for the age of the earth which have been derived in quite another way *from* radioactive phenomena



At 11 o'clock: June 7
At 10½ o'clock: June 14
At 10 o'clock June 22.

At 9 o'clock: July 7
At 8½ o'clock: July 14
At 8 o'clock July 22.

At 9½ o'clock: June 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later 12 o'clock on June 7 etc.

NIGHT SKY: JUNE AND JULY

The Planets

Mercury is a morning star all through June, and is best seen at the beginning of the month, about the time of the elongation on the 3rd. He is then 24 degrees from the sun but nearly 9 degrees south of him, so that he rises only about one hour and ten minutes before the sun, and is not conspicuous.

Venus is still an evening star, conspicuous in the early part of the month, but drawing in closer and closer to the sun until she is lost to view before its close Telescopically she is a beautiful object—a crescent like the moon four days old when the month begins, but growing ever narrower, and at the same time larger in diameter, until she becomes merely a thin semicircle of light

Mars is in Aquarius, and is steadily growing brighter as he approaches us By the end of the month he is only fifty million miles away, is 17 seconds in apparent diameter—two-thirds of the maximum value which he will reach in August —and looks almost as bright as Sirius He is still far from opposition, and does not rise until after 10 30 P M

Jupiter is in opposition on the 5th, and is visible all night long. He is in Ophiuchus, *on the edge of Scorpio*, and nearly 22 degrees south of the celestial equator This counts against him in our latitude, but even so, he is brighter than anything else in sight except Venus.

Saturn is in Virgo, about 5 degrees east and a little north of the bright star Spica, which he somewhat surpasses in brightness. He is due north at 8 P M in the middle of the month, and remains in sight until 1 30 A M Uranus is in Pisces, and comes into quadrature west of the sun on the 12th, rising just after midnight, and being observable in the early morning Neptune is in Cancer, and is well down in the west at sunset, so that he is hardly observable, even with the telescope

The moon is new at 10 A. M on the 2nd, in her first quarter at 9 A. M on the 10th, full just before midnight on the 16th, and in her last quarter at 9 P M on the 23rd She is nearest the earth on the 16th, and farthest away on the 1st and again on the 29th During the month she is in conjunction with Mercury on the 1st, Venus on the 5th, Neptune on the 7th, Saturn on the 12th, Jupiter on the 16th, Mars on the 21st and Uranus on the 22d

On the 28th, the bright star Aldebaran is occulted by the moon, and is hidden (from Washington) for more than an hour, from 8:30 to 9 48 A. M. As this happens in broad daylight, it can unfortunately be seen only with fair-sized telescopes.

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each The official printed copies of patents include complete descriptions and drawings of the inventions disclosed State the patent number to insure receipt of the desired patent copy

7 TITLE TO PATENT RIGHTS

TITLE to a patent right is vested in the first instance, by "occupancy," in the inventor of the subject-matter thereof. This title to the personal property which a patent right constitutes, is inchoate during the period between the creation of the invention and the issue of the patent. Nevertheless, this inchoate right is assignable, and such assignment will convey legal title to the letters patent, when granted, and if the deed of assignment so requests the Commissioner of Patents, the patent will issue to the assignee direct. An assignment of a patent, which must be in writing, may be both conditional and unconditional, entire or partial, and may even be limited territorially or in point of time While a true assignment must be in writing, an equitable assignment, that is one which is really an agreement to assign, may be oral. Under our statutes, recording an assignment in the Patent Office within three months of its execution, is necessary to insure title in the assignee, as against a subsequent purchaser for value and without knowledge of the assignment. Title to a patent does not pass to the heir of a deceased owner of the patent, but goes to the executor or administrator of the estate, and he alone can effect a transfer, though of course patent rights may be disposed of by will or in accordance with the laws of decedent estates as in the case of any other personality A patent may be assigned to a married woman, an infant or even a person under guardianship, and such parties may also assign their inventions or patents by complying not only with the provisions of the United States statutes, but also with the laws of their particular states, covering such transfers by persons of that status in respect to other personal property

Pertaining to Aeronautics

AIRCRAFT—Consisting of two gas bags joined at the front and rear ends, the propellers being disposed adjacent the under side Patent 1481448. J Whalen, 811 Oakdale Ave., Chicago, Ill.

Chemical Processes

PROCESS FOR THE PRODUCTION OF THERAPEUTICALLY ACTIVE CONSTITUENTS OF OILS, BALSAMS, RESINS AND EXTRACTS — By means of a cholic acid Patent 1479695 F Boedecker, Berlin Tempelhof, Germany

TREATMENT OF SULFUR AND OXIDIZED ORES—Especially applicable to ores containing minerals of silver, lead, and zinc. Patent 1480439 H. J E. Hamilton, North Broken Hill, New South Wales, Australia.

Electrical Devices

INDICATING DEVICE—For visually indicating to the occupants of a kitchen an order taken at a remote point. Patent 1479098. B. James, 4035 Indiana Ave, Chicago Ill.

ELECTRICAL INSTANTANEOUS WATER HEATER WITH CONTINUOUS CIRCULATION, WORKING AT DIFFERENT VOLTAGES—Adapted to be fixed at any water supply Patent 1480515 A DeMarchis, 212 Via Cola de Rienzo, Rome, Italy

CIRCUIT CLOSER—Which operates when the temperature drops below a predetermined point or in the event of fire Patent 1480102 J C Olsen, address Mrs. S Olsen, 3915 3rd St., N E. Minneapolis, Minn

CIRCUIT BREAKER—Subject to fluid pressure in a cylinder, as for example a fire pump Patent 1480442 J T Heck, Hendrick, Ind

HOODED EXAMINING LAMP—Illuminated by small electric bulbs, and capable of being worn on the face in the manner of spectacles. Patent 1481224 A Pimienta, 63 W 68th St., New York, N Y

CIGAR LIGHTER—Operated by means of an electric current and adapted for use on automobiles. Patent 1481383. J Nelson, Winter Park, Fla.

TROLLEY WIRE GUARD—Designed for use in protecting trolley wires mounted in mines. Patent 1481693. G W Creech, Twila Ky

ELECTROMECHANICAL LAMP—In which the bulb contact is composed of a flexible metallic strip, not susceptible to jars or shocks. Patent 1483055. P Blot, c/o Societe Blot Garnier & Chevalier, Paris, France

ELECTRIC FENCE—The wires of which are only energized at the time a person or animal attempts to pass through Patent 1483005 A. D McNair, Fayetteville, Ark.

ELECTRIC CONNECTION—Whereby conductors may be joined by a compact metallic lock, without the use of solder Patent 1482268. C. A. Deuscher, 233 St. Anns Ave., Bronx, N Y

RADIO APPARATUS—In which positive electrical connections are established between the station coil and rotor coil in a minimum capacity Patent 1481959 R. W French, 508 S. Francisco Ave, Chicago, Ill.

Of Interest to Farmers

ANIMAL HOPPLE—Particularly intended for preventing a cow from kicking while being milked Patent 1480443 E. Herman Fairfield, Iowa.

DRAFT EVENER—Adapted for attachment to a grain harvester, or other farm implement. Patent 1480204 C. T Hansen, Big Sandy, Montana.

GUARD FOR HARVESTER — Particularly adapted for harvesting oats, in a field where corn was grown the preceding season. Patent 1480244. U. H. Cramer, R. No 2, Box 60, Minonk, Ill.

UNLOADING DEVICE FOR CORN—Having means for storing the corn into a plurality of piles, which may be readily moved from the wagon. Patent 1483098. P M. Rindesbacher, c/o Peoples State Bank, Stockton, Ill.

Of General Interest

CONNECTOR FOR LOOSE LEAF BINDERS—That may be attached to a fabric by pressing the members into engagement Patent 1479740 L Reiter, 102 Westfield St., Providence, R. I

SHUTTER ATTACHMENT FOR DOORS—By means of which a door may be secured partially opened Patent 1479312. Lydia M O'Harrow, 481 So Dubuque St. Iowa City, Iowa

HAND BAG—Which admits of ready access for the removal and placing of articles therein Patent 1479763 N Wendel, 1336 Decatur St. Brooklyn N Y

DRAWING APPARATUS—Whereby the operator could derive considerable assistance in reproducing objects Patent 1479091 R. P Anstock, 26 West Center St., Mahanoy City, Pa.

FISH LURE—With a smooth outer surface to prevent entanglement with weeds hooks being concealed Patent 1479052 C Cranstone, 210 34th St., Newport News Va

RECEPTACLE—In the form of a hand bag or the like with reinforced frame. Patent 1479699 H Delman, 1595 Madison Ave, New York, N Y

MATCH STRIKER—Especially adaptable for use on the ordinary corn cob smoking pipe Patent 1479427 W Chalmers, 1024 4th St, Sacramento, Calif.

COMPOSITE BRICK AND TILE WALL CONSTRUCTION—Which provides a continuous vertical air passage through the wall Patent 1479379 W G Demarest, 47 W 34th St., New York, N Y

DENTAL FLOSS HOLDER—Whereby the floss may be held under tension Patent 1479364 W R Browne, Wyoming N Y

TRIPOD—With provision for locking the legs against movement on a slippery surface Patent 1479765 E E Whiting, Millor, Mo

TABLE—Having means whereby desired lengths may be measured and cut from a roll of fabric. Patent 1480168. W S Lambert, c/o Lambert Dry Goods Co, Geneseo Ill

LAWN SPRINKLER—By means of which the water is spread with a revolving action Patent 1480507 G W Coblentz, J R. Faries, and H P Bond, c/o Fisher Flouring Mills Co., Tacoma, Wash.

EDUCATIONAL APPLIANCE—For producing objects, geometrical figures, scenes or the like, in colors. Patent 1480458. S D Mershon, 222 West Milton Ave, Rahway, N J

COMBINED POSTAL AND ADVERTISING PILLAR—For receiving mail matter, and which may also be illuminated to display advertising matter Patent 1480469 G Robertson, 297 Carrington St., Adelaide, South Australia.

CARD HOLDER FOR TYPEWRITERS—Which is capable of use with any standard make of typewriter Patent 1480440 W A Hardman 98 So. Oxford St Brooklyn N Y

SASH-GEAR BALANCE—To prevent the binding and sticking of window sash Patent 1480453 L Lane Estacion Laguna, Chihuahua, Mexico

DRY MASH FEED HOPPER—With agitating means for causing the feed to be discharged into the feed trough. Patent 1480497 M Brandt, Toms River, N J

LIP STICK HOLDER—Adapted to project the cosmetic when it is desired to use the same Patent 1480449 W G Kendall c/o H Rigaud, 75 Barrow St Newark, N J

GUN—Which may be gripped within the palm of the hand, and carried concealed for defence Patent 1480521 J Faller and I Lapidus, 1960 66th St Brooklyn, N Y

TOILET SEAT—Arranged to accommodate either a sectional wood filling or a composition filling Patent 1480516. G C Dobson, 230 Ancon Ave Pelham Heights N Y

FLY PAPER—Which may be used in cone shape upon a table or may be suspended Patent 1480539 J Grecu, 6042 12th St. Detroit, Mich

POISON DISTRIBUTOR—For use in dispensing poisons for killing insects on cotton or potato plants. Patent 1480154 P F Crutchfield, address R L Brackwell Calhoun, Ga.

ANIMAL TRAP—Adapted either for trapping moles, rats, weasels or other animals Patent 1479853. I C Gamboe, 3639 44th Ave, S W, Seattle, Wash

BRIEF BAGS—With strip elements reinforcing the same and a space for identification card. Patent 1481182 M Brooks c/o Lefton Mfg Co, 15 W 27th St New York, N Y

GROMMET—Formed from a single piece of metal, as a substitute for two-piece grommets Patent 1481217 R E Maloy 1146 Lake St., Oak Park Ill

ADVERTISING DEVICE—Comprising a panel cut out to receive a specimen of the article advertised Patent 1481171 M R. Wood 218 William St., New York, N Y

THREAD FOLDER AND CUTTER—Which may be attached to the center of the spool by spring means. Patent 1481185 J H Burns and J Anderson 12 E 86th St. New York, N Y

ICE REMOVING APPARATUS—For removing blocks of manufactured ice from the cans in which they are formed Patent 1480703 J C Ward, c/o R. F. Masterson, 441 Keith Bldg, Beaumont, Texas.

RULE—Adapted for use by opticians, optometrists and oculists Patent 1480584. E. M. Wilhite, Shelbyville, Ind.

FISHING FLOAT—Which may be quickly attached to or removed from a line without knotting the same Patent 1480655 G E. Bennett, 25½ No Centre St, Corry Pa.

BRIDGE TOOTH AND LOCK IN BACKING—Whereby the tooth is firmly united but capable of ready removal in the event of break age Patent 1481200 A A Kauffman, 756 Broadway, Brooklyn, N Y

AQUARIUM—Having no metal on the interior to injure the fish, and which is leak proof Patent 1481435 W Rossberger, 1030 Greenleaf Ave, Wilmette, Ill

ROLLER WASHLINE—In which the wash line may be rolled up and enclosed when not in use Patent 1481497 J Betz, 1114 St. Germain St, St Cloud, Minn

ATTACHMENT FOR BEDS, CHAIRS AND THE LIKE—Which affords facilities for raising or lowering a swingingly supported section Patent 1481756. S E Stickle Fort Rock, Oregon

BASE FOR POSTS—Such as cement fence posts stock yard posts and poles support ing electric wires Patent 1481745 J R. C Ruybal, Capulin Colo

CORD CUTTER—With means for guiding the cord to the knife and preventing injury to the fingers Patent 1481725 G W Moore, 75 Blanco Place Jamaica N Y

CHECK BOOK CLAMP—For holding or folding check book in a flattened condition when in use Patent 1480196 R W Cudworth, 1114 Leavenworth St San Francisco, Calif.

KNOT TYING DEVICE—For forming knots in twine used in tying up packages and the like Patent 1481754 M Stalson 205 22d Ave, North Minneapolis, Minn

BATH—So arranged that when out of use it looks like a chest or piece of furniture. Patent 1481675 K Beresford 16 Karl Theodorstrasse, Meran Italy

SLING FOR CONTAINERS—For supporting container for fruit when it is being picked, thereby saving one handling of the fruit Patent 1481418. A E. Darby, Lakeside, Wash

COAL SAVING COMPOSITION—Consisting of sand, fine coal ashes salt and water to make a mortar like mass Patent 1481456 O O Cooper, c/o Chicago & Great Lake Co, 311 River St., Chicago Ill

PHOTOGRAPH AND THE LIKE—Referring to the mounting of a photograph to produce a novel appearance Patent 1480198 Josephine Denkhoff 1326 49th Ave San Francisco, Calif

TRAVELING BAG—Which presents a neat, smooth finish on the inside adjacent the hinges for opening and closing Patent 1480175 E G Merwin, 549½ Williams Ave, Portland, Ore

MOTION PICTURE SCREEN AND METHOD OF PRODUCING SAME—The screen being adapted to reflect pictures with a minimum strain on the eye Patent 1480205 L W Hill, 2219 Geary St San Francisco Calif

CIGAR LIGHTER—In which the gas is completely cut off when not in use and is ignited by electrical circuit Patent 1482098 S Stocking Herscher Ill

COMB—The teeth of which can be readily removed for replacement or cleaning Patent 1482242 S Michaud c/o Hotel Grand, Roseburg Oregon

ICE CREAM DIPPER—Including a bowl, having a guide lip and a scraper attached Patent 1482094 W R Ripley, Sherman, Calif

SCOREBOARD FOR BASEBALL GAMES—Provided with a housing for the operator who manipulates the indicator plates Patent 1481916 L D Long Charleston S C

CURTAIN—For screening inclosed porches and the like, the device may be easily raised or lowered Patent 1482059 S B Zimmer, 1253 W 37th Place, Los Angeles, Calif

BELT FASTENING HOOK—Having a plurality of shanks hooks and tangs easily applied to belt ends as a fastening Patent 1482282. M L. Adams, 808 1st Ave So, Seattle, Wash.

ROOFING TILE—With notched projections for engaging the notches of an adjacent tile Patent 1482267 B Schnitzler, 220 Hudson Ave Edgemere, L I, N Y

CLOTHESLINE SUPPORT AND TIGHTENER—Which affords means for lowering the line to permit the application or removal of the clothes Patent 1482268. C Schopper, 523 W 134th St. New York N Y

GALVANIZING RACK—By means of which a plurality of steel bars may be simultaneously handled for galvanizing Patent 1482066. L T Curtis, 40 Bloomfield Rd, Burlingame Calif

CLOTHESPOLE So constructed that a line supported thereby will not slip Patent 1482278. B Trent, 103 Trenton Ave Lakeview, N J

COIN MAILING-CARD—Which is provided with slots and retaining means for preventing the coins being disengaged Patent 1482433 W G Hoffman and R S Hintze, 1231 N Mansfield Ave Chicago Ill

INSECT TRAP—Constructed to contain an insecticide particularly attractive to boll weevil and other insects Patent 1482092 A Hoffbauer, 367 52nd St Brooklyn N Y

CURB COCK—In which all moving parts are protected from rust or corrosion by a casing of heavy grease Patent 1483001 A Kurre, 283 5th Ave, Brooklyn N Y

BRIDGE FOR BILLIARD AND POOL TABLES—Which may be positioned at any angle with respect to the cue ball irrespective of other balls on the table Patent 1482082 W W Banks, 28 Merion Ave Bryn Mawr Pa

PROCESS OF MANUFACTURING AND LAYING BITUMINOUS SHEET PAVEMENT AND MATERIALS THEREFOR—Enabling the pavement to be laid cold and rolled to insure adhesion Patent 1482900 F C Alsdorf Box 417, So Norwalk Conn

OUTFIT FOR PRODUCING DRINKS—For beverage, medicine or other purposes Patent 1483015 H Schnackenberg, Box 101, Stroudsburg, Pa

DRESS SEPARATOR—Adapted to be suspended from a pole or other support between garments Patent 1483058 P M Frank c/o Nathan H Jacobson & Co, 30 E 31st St, New York N Y

CHANGE PURSE AND BILL FOLD—Which will add but slightly in bulk to the usual form of bill fold Patent 1481020 F Sperling, c/o Sperling Co, 1261 Broadway, New York, N Y

DENTAL ARTICULATOR OR RELATOR—Having movable jaws which permit of adjustment Patent 1482993 J Homer c/o Homer Relator Co, 384 Atlantic Ave Boston Mass.

PACK OF GAME CARDS—On the corners of which appear numbers from 1 to 100 making possible the playing of fifty mathematical games Patent 1484564 R H Riffert, 2405 W Lehigh Ave Philadelphia Pa

TOOTHBRUSH—Which will allow water to enter through the handle to the bristles, flushing the teeth at the time they are brushed Patent 1479275 H W Bell 551 Cedar St San Francisco, Calif

Hardware and Tools

EXPANSIBLE REAMER—In which the adjustable blades may be used in openings of various diameters Patent 1479079 A Kutchera 921 Front St., Bismarck N D

NUT LOCK—Of such construction that the nut cannot become loosened by vibration or shock Patent 1479071 J A Hatfield 511 W Railroad Ave Fort Worth, Texas

HINGE CONSTRUCTION—Capable of bearing great strain yet using a minimum of metal Patent 1479705 E Flagg 111 E. 40th St New York N Y

BOLT AND CHAIN LOCK—Which may be used simultaneously or independently the operation of both being independent Patent 1179709 M J Goldstein, 237 E 174th St., Bronx N Y

PORTABLE HANDLE—In the form of tongs adapted for lifting boxes and the like Patent 1479711 C Haarburg 3238 Flournoy St, Chicago Ill

LOCK—Wherein the bolt cannot be retracted except by the actuation of proper means The inventor has been granted two patents of a similar nature Patents 1479743 and 1479744 A Salata, 207 E. 15th St New York N Y

COMBINED SAW JOINTER AND GAGE—Provided with accurate means for vertically adjusting the swaging gage, and filing gage members. Patent 1481818. G Anderson, Hotel Laina, 715 7th Ave, Seattle, Wash.

METAL FENCE POST—Having notches on its edges for attaching the wire retaining members Patent 1479291 P E Evans, 60 E 13th St Chicago Heights Ill.

DRILL HEAD—Whereby tools such as cutters may be introduced into a well casing Patent 14479872 F E Sackrider Apperson, Okla

COMPOUND TOOL—Which acts as a pencil sharpener and finger nail cleaner Patent 1479921 J J Miller, Box 608 Chadron, Neb

DENTAL SHOULDER-CUTTING INSTRUMENT—Which provides means for shielding the gum and neighboring teeth from the cutting tool Patent 1480730 J A Lentz 44 No 1st Ave, Phoenix Arizona

SHARPENER FOR SAFETY RAZOR BLADES—Which will operate on blades of practically all the standard types now in use Patent 1482265 J M Schiltz 1908 Cadez, Dallas, Texas

LOCK—Of the mortise type having a sliding bolt and gear, whereby the operating members are interlocked Patent 1482298. B Greenison, 853 7th Ave, New York N Y

JACK—Which will raise an object from close to the ground, and will provide for instantaneous release Patent 1481822 W Bengel, c/o Ark Bank & Trust Bldg, Newport Arkansas

LOCK—In which rotation of the latch is prevented when desired Patent 1482974 E. Dacle 2066 7th Ave New York N Y

APPLIANCE FOR CLAMPS OR CRAMPS AND THE LIKE—Which will effectually force together boards or pieces of timber during the process of nailing Patent 1482089 L F Hering 109 Cameron St. Launceston Tasmania

Heating and Lighting

RADIATOR BRACKET—For suspending a radiator from the side wall of a room and eliminate supporting feet Patent 1480456. F J Mullen, 2328 University Ave Bronx, N Y

DRIER—Which will enable the analyst to determine the amount of moisture in laboratory tests. Patent 1482274 G L Spencer c/o Cuban Am Sugar Co, 129 Front St, New York, N Y

METAL WORKING FURNACE—Particularly intended for use in connection with manufacture of wrought iron Patent 1483062 O S Pulliam, Room 480 50 Church St New York N Y

Machines and Mechanical Devices

GUARD—For speed governors on machinery, which may be moved for adjustments Patent 1478953 L and E A Happ 29 New Jersey Ave, Brooklyn N Y

COMBINATION COMPRESSOR AND VACUUM PUMP—Which is convertible and includes novel lubricating means Patent 1478929 C M Tursky 306 W 56th St. New York, N Y

SILENT KEY TYPEWRITER ATTACHMENT—Which may be attached to any form of typewriter Patent 1478600 L Cardoso c/o Lazard Freres, Cie, 120 B way, New York, N Y

DRAG SAW—The accidental movement of which is prevented while the device is in action Patent 1478573 R. H McDonald, Scio, Oregon

ATTACHMENT FOR HEMSTITCHING MACHINES—Which may be used for forming picot edges Patent 1478379 F and H Burgert, 51 W 20th St, New York, N Y

OIL WELL EQUIPMENT—For preventing sand in the oil from lodging between the plunger and the working barrel Patent 1479208 R. D Thompson and J Penrod, 1241 E 9th St, Okmulgee Okla

GARMENT MEASURING DEVICE—Whereby a skirt may be arranged to hang at a desired level Patent 1479119 J Vrana, c/o Geo. B Efantis, Route 2 Hinsdale Ill

MOUNTING FOR SEWING MACHINE HEADS—That may be easily moved from place to place for sewing filled bags Patent 1480457 J F Martin 66 Exchange St, Pawtucket, R I

SAFETY CONTROL DEVICE—For the cable drum of a hoister which will automatically bring the drum to a stop Patent 1480170 H H Logan, 1765 Winnemac Ave., Chicago, Ill.

SAVE ALL—For separating the pulp fibers from the waste water from paper-making machines Patent 1480500 G W Brown, c/o W E Rosebush, c/o Inland Empire Paper Co, Milwood, Wash.

MACHINE FOR CUTTING OFF AND THREADING PIPES—Which may be operated by power or by hand. Patent 1481191 T V Elliott and C Schaefer, New Brunswick, N J

POLISHING DEVICE—By which metal plates may be cleaned and polished by a single machine Patent 1481242 J J Mueller Jr c/o Superior Metal Co, Bethlehem, Pa

PLASTIC MOULDING MACHINE—For forming hollow building blocks, whereby the cores side and end walls may be conveniently removed Patent 1481686 J F Caldwell, 2722 No Broadway Los Angeles Calif

SLAUGHTERING DEVICE—With means for thrusting a knife with tilting motion into the animal's body Patent 1480197 R W Cudworth 1144 Leavenworth St San Francisco, Calif

SLIP—Especially adapted for use in oil well operations. Patent 1481378 G F Le Bus, c/o Le Bus Rotary Valve Co Electra, Texas

CENTRIFUGAL SEPARATOR—Providing a machine adapted to concentrate solid matters suspended in liquids Patent 1481426 F W McEntire, Hotel Utah, Salt Lake City Utah

SWITCH MOUNTING FOR MACHINES HAVING INDIVIDUAL MOTORS—More particularly for use in connection with knitting machines and the like Patent 1481280 J P Bivens Gastonia, N C

BEARING—In which friction is reduced to a minimum, with elements which may be renewed when worn Patent 1481705 M G Gimeno, 17 Cottage St., Bayonne, N J

BELT CALCULATOR—With scales for calculating the stretch of known lengths Patent 1481702 G. R Fickert, 611 Bloomfield St, Hoboken, N J

PITMAN OILER—Intended to prevent over heating in the pitman of a mowing machine Patent 1481918 T F Lowe, Oconomowoc, Wis

DISPLAY DEVICE—Comprising mechanism for rotating and displaying continuous various articles Patent 1482332 F Weren, 196 Palisade Ave, Jersey City, N J

ADJUSTABLE CHUTE SPRING FOR TYPESETTING MACHINES—Which may be easily associated with all standard forms of type setting machines Patent 1483017 R Shields, 500 Coney Island Ave. Brooklyn N Y

HACKLING MACHINE—Wherein fiber may be secured from the palmetto boots, jackets leaves, and stems by one operation Patent 1483034 L B Wootton c/o Baldwin & Velter, Law Exchange Bldg Jacksonville Fla

GRIPPER FOR PRINTING PRESSES—By means of which each finger is given a resilient gripping action independently Patent 1483057 A W Warsen 31 Ashford St Hartford, Conn

PROJECTING MACHINE—Which is readily portable and especially adapted for use in connection with illustrated lectures. Patent 1483025 G M Tucker, Jr Box 747 Albany N Y

Prime Movers and Their Accessories

COOLING MEANS FOR INTERNAL COMBUSTION ENGINES—Providing means whereby air may be circulated through a housing positioned about the engine Patent 1479412 H N Harper Kidd Bldg Ruston, La

CAM FOLLOWER GUIDE—To prevent a cam follower from pumping oil through the guide Patent 1479735 V W Page c/o Victor Page Motor Co Melrose Ave Stamford, Conn

CARBURETOR—With means for automatically scavenging the engine cylinders at any desired time Patent 1480478 G H Taber, 2719½ Baldwin St., Los Angeles Calif.

ROTARY GAS ENGINE—In which the power developed is imparted without the necessity of the usual crank shaft Patent 1481220 E R. Nichols, 5510 Blackstone Ave, Chicago Ill.

FUEL MIXER—By means of which it will be possible to obtain a more perfect combustion Patent 1481118 R. L Bennett, 410 E. 143rd St., Bronx, New York.

TIMER—Which may be readily applied to a Ford engine, without altering the construction of the same Patent 1481950. W. A. Ashley, 615 1st St., Liverpool, N. Y.

Railways and Their Accessories

SHIFTING APPARATUS—Having means for lifting a car clear of the tracks and carrying it to an unloading platform, without interfering with traffic Patent 1479767 J J Wolf, 230 Mechanic St., Boonton, N J

SLIDING DOOR SUPPORT—Adapted for use in connection with freight cars, and the like Patent 1480641 F Tetzlaff, c/o Konnoson & Konnoson, 174 Broadway, New York N Y

FREIGHT CAR DOOR—Particularly adapted for use in loading or unloading grain or any loose bulk commodity Patent 1482307 K R. Koskinen c/o Finnish Book Co, 4308 8th Ave Brooklyn N Y

Pertaining to Recreation

TOY MACHINE GUN—Which is simple in construction and durable in use. Patent 1480499 A R. Brown c/o E. W Brown 426 So 4th St., Louisville, Ky

TOY ELECTROSTEAM ENGINE—In which the steam is generated by means of an electrically heated unit. Patent 1480445 S. D and W E. Horlacher Tunkhannock. Pa.

TOY—Comprising a propelling ball loosely fitting within a cylindrical body, which may be drawn over the floor Patent 1481227 C Ridderhof, Times Building 42nd St., New York N Y

TOY HELICOPTER—This inventor has been granted two patents of a similar nature, in which the propeller action of the toy is by means of a twisted rubber band Patents 1481826, 1481827 L W Brown, 106 E. Clinton St, Clinton, Missouri

Pertaining to Vehicles

PISTON RING HOLDER—Especially adapted for use when inserting pistons into cylinders Patent 1478724 C Barchus, Room 6 Lowenburg Bldg Natchez, Miss.

SHOCK ABSORBER—Formed by a coil spring clamped between the cantilever and semi elliptic springs Patent 1477959 R. D Hughes c/o Red Giant Tool Co., Box 114, Lynchburg, Va

DIRECTION INDICATOR—With means for actuating the same from the steering post Patent 1478916 E L Robinson, 315 S Hewitt St Los Angeles, Cal

AUTOMOBILE PERISCOPE—Which enables the operator to obtain a vision of objects in front or behind Patent 1478650 L Hallengren c/o J R. Leppo Atty, Bank of Italy Bldg, Santa Rosa Cal

WHEEL FOR AUTOMOBILES—Of the demountable type which may be easily assembled Patent 1478437 S Kaplan and H M Howell Monroe La

LUBRICATING SYSTEM—Comprising means for supplying lubricant to bearings, and like parts Patent 1478513 P H Gaskins 1207 Graham Bldg, Jacksonville Fla

DEMOUNTABLE ATTACHMENT FOR TRACTORS—Whereby heavy articles may be transported in the same manner as by a truck. Patent 1479422. J F Bailey, 819 Maple St., Columbia S C

SIDE FRAME BRACE AND RADIATOR SHELL—Particularly adapted to a chassis structure in which the motor is of the air-cooled type Patent 1479784 V W Page c/o Victor Page Motor Co, Melrose Ave., Stamford, Conn

EXHAUST MUFFLER FOR MOTOR CARS—With means for reducing the back pressure upon exhaust gases passing therethrough Patent 1479714 F J Herdle, 1847 W Huron St., Chicago Ill

VEHICLES—With shock absorbing means in the form of cylinders and coiled springs Patent 1480279 W B MacLachlan, 3246 2nd Ave, So Minneapolis Minn.

CURTAIN SWING—Providing a hanging arm whereby the curtain can be swung to leave an open doorway Patent 1480498. J Z. Benson, Box 43, Station "A", Marshalltown Iowa.

Designs

DESIGN FOR A BUILDING TILE. Patent 63264 Q Monier, Box 411, Tucson, Ariz

DESIGN FOR A BATHING SUIT CASE. Patent 63496. J Schacht, 54 E. 121st St, New York, N Y

DESIGN FOR A CHANDELIER. Patent 63577. A Miller, c/o Radient Lighting Fixture Co., 33 Bleecker St., New York, N Y

DESIGN FOR A TIRE TREAD—Patent 63578. L. G Nassoiy, 921 Cleveland Ave, Niagara Falls, N. Y.

The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals Other digests appear elsewhere in this issue

Electrical

Motion Pictures Aid Testing Staffs.—It has become increasingly evident during recent months, says *Electrical World*, that motion pictures have a utilitarian value to engineers as technical keys for unlocking many doors to increased efficiency in investigation and operation One of the most recent applications of such pictures is to record simultaneously the readings of many indicating meters. In machine or plant tests requiring the accurate and simultaneous readings of many instruments much difficulty has been experienced because of the limitation of time the number of readings required and the inaccuracy of readings made in a hurry by human observers By the use of motion pictures it is possible to arrange the meters in a manner to expose the dials to the camera and to obtain a continuous and accurate series of records which can be read and interpreted at any later time in a leisurely manner In power stations research and test laboratories and industrial plants this new tool for testers is sure of a welcome and a little study shows a multitude of other engineering applications of a similar character where it can advantageously by employed

Power Transmission Without Wires.—Commenting on the subject of the high potentials brought about in transmission lines by lightning discharges E F F Creighton of the General Electric Company makes a detour over what he apologetically characterizes as dangerous ground—the fascinating problem of power transmission without wires The proposition contains some attractive figures For example the distance up to universal conductance all around the 25 000 mile circumference of the earth is only a few miles, while it is 3 000 miles from San Francisco to New York The outer conducting envelope of the earth might be fed with electrical energy at any number of points where huge hydraulic power is being wasted and suitably tapped anywhere in civilisation where it can be utilised Immediately there flashes forward the great advantage of using in New York and Chicago the waste power pouring over Victoria Falls Africa Attractive the thought, also to save millions of tons each year of the limited supply of the world's coal Why not? asks the dreamer There is a close connection between the subject of atmospheric high conduction and direct lightning strokes The desire is double barreled—the first barrel is to bait an encouragement in the study of lightning phenomena in its most interesting phase the highly conducting stream the second is to point out how little we know of it. Who knows but that a study of the lightning bolt which travels miles through an insulating atmosphere may not reveal a method of reaching the conduction of the upper atmosphere? Stranger things have taken place in research As practical matters stand now A B Hendricks has reached two million volts in designs of power transformers How many more million will be necessary to reach from a super Eiffel Tower on a mountain top through a captive balloon to a high conducting layer? Incidentally an oscillator at a half million volts will send out luminous conducting streamers longer than one's arm, which waves around in the air and ends not in a conductor but apparently in invisible nothingness It is startlingly suggestive —*Electrical World*

Swedish Method of Impregnating Telegraph Poles—The spawn of the fungi which produce dry rot in wood require for their growth a suitable degree of moisture and access to the oxygen of the air Their maximum development takes place at 18 per cent of moisture in the wood, and the growth decreases at both a lower and a higher percentage. The top of a pole may often get as wet as this, but it dries too soon for the fungi to get to work The bottom is apt to be constantly wet, but too wet for the fungi. But there is generally a point between these two parts at which the correct amount of moisture 18 per cent remains fairly constant and this is the zone where the fungi do their dirty work. One apparently good way to get around this difficulty would be to fill this zone with loose stone To do this would be merely to transfer the inevitable zone further down the pole Tarring this part of the pole is unsatisfactory for the tar does not penetrate the deep cracks as does creosote where impregnating has been done under pressure In fact, tarring may hold water in, thus acting as a detriment. A new process has been used in Sweden during the past four years The poles are charred with a special torch This protects the surface for there is no nourishment for the fungi in the charcoal on the surface. In addition charring opens every crack that will ever open, and temporarily opens them wide This permits a creosote spray to reach the interior of the pole Later they close or partly close The charcoal being porous, absorbs more creosote than does wood and this gradually soaks in and spreads The method has been very successful in Sweden Norway, Denmark and Finland.—*Electrical World*, 83 8 3 pp ill

A Telephone System for Europe is a project that is now receiving considerable attention No doubt the Europeans are inspired by the excellent Bell telephone system which covers the United States with such thoroughness that one subscriber can reach any other subscriber no matter what the distance may be While admitting the desirability of establishing a network of underground cables for international telephone services, it has been decided for the present, to regard 1000 miles as the limiting distance for lines consisting of cables only and to employ aerial lines in cases where greater distances are involved Repeaters of the vacuum tube type will be used on both aerial lines and on cables, and special consideration is to be given by the various administrations represented at the conference to the regulations required to protect long-distance telephone lines from disturbance by electric power transmission systems The appointment of a permanent committee representing all European countries, for the purpose of maintaining continuous cooperation and the establishment of a small permanent secretariat to act on behalf of the committee and to facilitate the exchange of technical information, are other items in the recommendations of the conference.

Piezo — Electricity of Rochelle Salt Crystals.—Some time ago we carried in our columns an account of the so-called speaking crystals, which are nothing more than rochelle salt crystals that display strong microphonic characteristics. The effect varies with the treatment of the crystal and is very marked when the crystal is dried in alcohol and baked For this purpose the crystal is dried in 90 per cent alcohol for 24 hours and in 100 per cent alcohol for about four hours, and then baked at 40 degrees C. for several days A twisting couple about the principal axis excites the greatest electrification. A crystal on a phonographic record will generate several volts, with sufficient power to operate a large number of telephone receivers. As many as 200 receivers, each of 12,000 ohms impedance, have been operated from one crystal. By means of a vacuum tube amplifier, very good transmission of speech may be obtained by using such crystals at both ends of a long as the sole transmitting and receiving apparatus It is rumored that a loud-speaker based on these speaking crystals is soon to appear on the market.—*Facts from Faraday Society Transactions.*

General

The Demand for Tacks has passed through periods of wide fluctuation due to changes in style and to new inventions and new customs. Some 30 years ago carpets were used extensively and the demand for tacks was heavy. The increasing use of rugs in place of carpets, however, caused a falling off in the tack industry. But rapid progress in the production of automobiles soon developed a new field for tacks. Variations in furniture design constantly are causing fluctuations in tack demand. The shoe industry always has been one of the chief outlets for tacks, but even here changes in design cause a variation in the number of tacks used. The rubber heel industry has shortened the average length of heel tacks by nearly 50 per cent. General household demand for tacks has remained fairly constant throughout the last 10 or 15 years and this accounts for a surprisingly large proportion of the country's production. The country's tack supply is turned out by a relatively few manufacturers, about 30 plants, and the machines which are used are made by not more than three or four companies.—*Iron Trade*, 74 13, 5 pp., ill.

Fuel Economizers are designed on the principle of admitting pre-heated air over the top of the fire. Usually these consist of some sort of a coil or box to be attached to the door of the furnace, on the inside. The air that enters them is heated by the fire before it issues through a number of small openings. Concerning devices of this sort the Bureau of Mines states that when coal is put on a hot fuel bed, and there is a rapid evolution of volatile matter, supplementary air is needed, and it might be even desirable to keep the firing door open for a few moments to supply this air. It is conceivable that such supplementary air might be more advantageously admitted nearer the surface of the fuel bed in finer streams and pre-heated. In most firing, however, this condition lasts for a relatively short time during the whole 24 hours and the Bureau believes that in most cases the efficiency would be reduced by too much supplementary air rather than by too little. If there were any lack of supplementary air it would be shown by the presence of carbon monoxide in the flue gases. Technical paper No. 303 shows that in tests made by the Bureau the amount of carbon monoxide is extremely small or none at all. The heat carried away by dry flue gases is an appreciable amount so that if we add to these dry gases they can be expected to carry away considerably more heat. The Bureau states that it cannot advocate these devices, at least where applied to small household heating plants.

Carbon Monoxide Fatalities from Natural Gas Heaters is the subject of an analytical study made by the Bureau of Mines and detailed in Serial 2572. The Bureau has not found any case where fatalities have resulted from natural gas heaters in which the heaters were connected to a flue or set in a fireplace from which the products of combustion could be carried off through the chimney to the outside. It was found that the rooms were, with one exception, tightly closed, and in many cases the cracks sealed up with weather stripping. It seems that even if a heater liberates carbon monoxide, fatalities are not likely to occur if the heater is connected to a flue and one or more doors and windows are partly open. This precaution is especially necessary if a heater is allowed to burn in a room in which people sleep. In fact, no one should sleep in a closed room in which any natural gas heater is burning. In some cases the rooms were of large size having more than 1700 cubic feet capacity. The fact that a room is of large capacity does not ensure that all natural gas heaters can be safely used in such rooms, unless the heater is properly vented to a flue. The main glaring cause of liberation of carbon monoxide is due to excessive gas flows arising from too large gas orifices. Adjustable orifices are dangerous unless limited to such a size that excessive gas flows can not be obtained even at the maximum gas pressure available in the locality where used.

Automotive

The Automotive Fuel Problem.—Recent advances in the design of gasoline engines have had fuel economy as the goal. It is quite possible that the engine of tomorrow will double the miles obtainable from a gallon of gasoline. This result can be accom

plished by (1) increasing the compression of the fuel charge and (2) by increasing the average percentage operating load on the engine Although increased compression ordinarily produces fuel knock," the successful development of "anti knock" substances within the past few years makes possible the use of very high compressions without incurring any ill effects. The percentage operating load may be increased simply by the introduction of more forward speeds of high gear ratio actuated by suitable automatic gear selectors. In this latter practice Europe has been somewhat ahead of us for a number of years In brief, then, it is entirely within reason to predict that by 1934 we shall have exhausted one-half of the petroleum available from wells Our importations of oil will be of great magnitude A *new and important industry*, that of winning oil from shale rock, will be on a firm commercial basis. Automobiles, although more than double in number will be much more economical of fuel and as a result, the cost of operation per mile is not likely to be any greater than at present.—*Tech Eng News*, 5 1, 2 pp

Automobilism in the United States is the title of a revealing article in *The Autocar* (see No 1481) Here we get a look at ourselves as an Englishman sees us automotively, as it were and the great majority of aspects of American motoring seem to have pleased him Referring to New York, after praising the 'clean smooth running taxis' he says traffic congestion is so severe that in the busy parts of the city during the daytime it takes longer to go anywhere by taxi than on foot The traffic problem is serious but has been tackled in an admirable manner Practically no walkers cross from side to side of the streets Streets in New York and other large cities are generally very well kept On the other hand there is liable to be very rough going due to repairs raised tramlines and bad pot holes There is undoubtedly a better average surface than in English town streets except for certain bad bits which are so bad that the springing on not a few British cars would be hard put to it to withstand them All main roads in the East and Middle West *are uniformly good* By roads are generally bad The marking of roads is well carried out as regards signposts. Service stations are generally neat and tidy Most American cars are black, and seen generally as a procession they give the impression of many hearses in a row The average American car is powerful quiet and sweet running The better class cars compare well with British cars as regards durability The weather conditions are such that a car does not keep its looks as long as in England The buying of cars on the installment plan is very common, and there are many banks which deal solely with such business Here are a few brickbats, perhaps deserved ones but many bouquets.

Mudguard Efficiency.—By far the loudest grumble which one hears about mudguards concerns the edge of the wing round which mud creeps in considerable quantities subsequently to fly off and cover the sides of the body, or even the rear passengers It is curious to find many of even the very large and expensive cars with singularly inefficient mudguards, and the point is that a very good guard can be made by curling the edge of the metal over to form a trough which conducts the mud downwards beneath the running board There are four possibly five, British manufacturers who have adopted this device, and incidentally, one of them uses the same type of mudguard for the least *expensive chassis produced* Not only does this gutter prevent mud creeping round the guard, but it also stops the edge of the metal from splitting —*Autocar* (see No 1482)

A New Airplane Launching and Landing Device.—The chief advantage of commercial aviation is its ability to carry goods, or passengers at a greater speed than that afforded by the present methods of transportation However much of this advantage is lost at the present time because of the time lost at the terminals in getting from the landing field to the city As an example, a person coming into New York City by the air line would land at one of the fields near Garden City He would then have about a two mile ride in a taxi to the nearest railroad station and a twenty mile ride by train to the city, thus losing most of the time gained en route. An interesting solution to this problem is offered by a Brooklyn, N Y., manufacturer through the

development of a device for landing and launching airplanes in restricted areas Briefly, the device consists of a flat, unobstructed platform made up of wood flooring on a light structural steel frame work. This platform is pivoted transversely in the center to allow it to be tilted to any desired angle and is mounted on a circular track similar to a turntable or turret, allowing it to be revolved into the wind for the launching or receiving of airplanes. The surface of the platform is fitted with various devices for slowing up the plane The size of the platform is determined by the weight and landing speed of the planes it is to handle the smallest dimensions being about 60 feet wide and 175 feet long Structurally the device is similar to other steel structures and offers no new engineering problems Electrically and mechanically also it is merely a new application of old ideas All the movements of the platform are made electrically and under the control of an operator located in a pilot house at one corner of the platform All controls are in duplicate The platform is also completely equipped with lights for night flying including flood lights, beacon lights and various signal lights—*Aviation*, 16 12, 1 p.

Braking on Four Wheels conclusively proved its advantages from the standpoint of rapid deceleration in tests staged in Washington last week by the Washington Section of the Society of Automotive Engineers working in cooperation with the Bureau of Standards. Of the fourteen cars which participated in these tests, ten had four wheel brakes and the remainder two-wheel brakes only Tests were made at 20 and 30 miles per hour on dry asphalt paving, and at 25 m p h on the same surface washed clean and still wet In the tests on dry pavement, the four wheel brake cars showed an average deceleration rate of 20 9 feet per sec per sec as against 11 1 per sec per sec for two wheel brake cars On wet pavement the corresponding figures were respectively 17 5 and 8 2 per sec per sec Expressed in terms of equivalent stopping distance from an initial speed of 20 m p h the average figure for four wheel brake cars on dry pavement was 21 1 feet and on wet pavement, 26 8 feet Corresponding figures for two wheel brake cars were 36 and 53.3 feet respectively

The Dangerous Fallacy that the atmosphere in a closed garage is safe as long as an automobile engine continues to function has been disproved by a test conducted by engineers of the Bureau of Mines An ordinary touring car of popular make which is operated daily, was placed in a brick garage having a capacity of approximately 3000 cubic feet, a dog was placed upon the driver's seat and the engine allowed to continue running at an idling speed which is much slower than the average motorist would use for warming up purposes. The doors of the garage were closed and after 20 minutes operation of the engine the dog lost consciousness and fell to the floor of the car An analysis of the air at this time disclosed the presence of 1 3 per cent of carbon monoxide which is sufficient to cause unconsciousness and death in a few minutes. The automobile engine was allowed to run until it stopped from lack of air which occurred at the end of two hours when the percentage of carbon monoxide present in the garage atmosphere was indicated as 2 1 per cent, an almost instantaneously fatal amount. The engine functioned six times as long as the dog retained consciousness, proving conclusively that the continued operation of an automobile engine in a closed garage is no indication as to the condition of the air and that the engine will continue to function long after the operator has lost consciousness. This experiment was conducted in a garage several times as large as the average one-car garage and it is safe to assume that a dangerous concentration of carbon monoxide would result in a one-car garage in less than half the time recorded in this experiment. In other words, the dog would have lost consciousness in about ten minutes after the starting of the engine, which would have continued running for about one hour The Bureau of Mines calls attention to the great danger of any one entering a closed garage for the purpose of shutting off a running engine. This frequently happens on occasions when a motorist starts his engine and leaves it running while he returns to the house for something he has forgotten. It is quite certain under such conditions that dangerous concentrations of carbon monoxide will occur in a very

short time if the garage is closed and when the motorist returns he is likely to encounter an atmosphere sufficiently charged with carbon monoxide to render him unconscious in two or three minutes and to cause his death if he is not promptly rescued.

Internal Losses in Motors vary with the speed and a large number of interesting considerations of this matter are discussed in *Automotive Ind.* (50 10, 8 pp) A friction horsepower curve is obtained by "motoring" the engine by means of an electric dynamometer, the torque on the field frame of the dynamometer then indicating the friction torque The test can be made in a number of different ways Ordinarily the engine is completely assembled and is "motored" with the throttle wide open The torque measured under these conditions represents both the various mechanical friction losses and the so-called pumping losses By pumping losses is meant the losses occasioned by gas pressure on the piston contrary to its direction of motion In order to eliminate the pumping losses in friction horsepower determinations it is customary to remove the valves and valve plugs (if the latter are used) as well as the spark plugs. Atmospheric air can then follow the motions of the pistons without appreciable resistance and practically all pumping losses are eliminated leaving only the losses due to mechanical friction A very extensive series of tests was made on a Pierce-Arrow six cylinder engine The engine was "motored" both completely assembled and with the throttle wide open, and with all of the valves and plugs removed from the cylinders. There was a material difference between the torques required to turn over the engine under these two conditions, and this represents the torque due to the pumping losses. This difference in torque amounted to 8 4 pound feet at 470 r.p.m., 16 4 pound feet at 1000 r p m, and 29 5 pound feet at 1700 r p m It will be seen from these figures that the pumping loss torque is very closely proportional to the speed It would appear that the flow of the charge through the carburetor is largely a streamline flow

The Trend of Automotive Advance is generally foreshadowed in the publication, *Automotive Industries* Most matters pertaining to the motor car are discussed by the personnel of the industry one or two years in advance of their adoption Theories are threshed out, experiments are described and interpreted, failures of specific types of devices are detailed In short, like all industries the automotive industry, with some regrettable exceptions, looks before it leaps, and the intelligent reader is placed in a somewhat similar position to get a forecast of what motor cars will be like a couple of years hence that a sitter-in at a tailor's national convention would be to know whether trousers will or will not have cuffs in 1926 When it comes to the theory of design of this or that part of a car how ever, long study and trial tests take the place of the whims that govern the choice of trouser cuffs. Reading of this sort is, however, neither as exciting as reading a Nick Carter novel nor so elementary that the non mathematically educated ash collector can follow it with vast satisfaction In another publication, *Tires*, one gets rather a different slant on some matters than one finds in the general press. For instance, the low pressure tire seems to be regarded by some members of the industry as a by no-means sure-to-stick innovation There is a feeling that this kind of tire was put on the market a little too soon, and that the dissatisfaction of some users of so-called "balloon type" tires is in danger of overtaking the advance of the real balloon tire. If another year had been let pass before the new tires were put out, everything would have been ready to "go the whole hog' instead of making a compromise that is not nearly as satisfactory as the full balloon tire Will the compromise tire fatally injure the chances of the real balloon? Some members of the industry seem worried

A Diesel-engined Motor Truck is now on the market in Germany The engine works on the true Diesel cycle, using a compression pressure of slightly over 500 pounds per square inch, the fuel charge being ignited by heat generated by the compression of the air No air compressor plant for injection purposes is used. There is an ignition chamber on top of the cylinder, in which a small quantity of the fuel ignites spontaneously and forces the rest of the fuel into the combustion chamber in the form of a very fine spray It is claimed that this engine can be operated on any heavy fuel such as crude oil, that the engine can be idled for any length of time and that it will carry a full load immediatly after an extended period of idling. In external appearance this power-plant does not differ materially from the conventional truck engine. The individual cylinders have both the inlet and the exhaust valves in the head, which are inclosed under an aluminum cover and operated by outside pushrods. The ignition chamber is arranged between the two valves. As is customary in engines of this type, the cylinder heads are cast separately. Starting of the engine is effected in two stages and usually by means of the electric starter During the first stage the exhaust valves are lifted off their seats by means of a hand lever The starting motor then cranks the engine over rapidly and the flywheel accumulates momentum. After a sufficient speed has been attained the exhaust valves are released by the hand lever, but they are prevented from closing entirely by small auxiliary cams. Not sufficient heat is developed by the compression during this stage of the starting operation to ignite the charge spontaneously, and ignition is effected by means of an ignition plug which carries a filament which is maintained in an incandescent state by means of current from a storage battery After the first ignition the camshaft is shifted axially into its normal working position, whereby the auxiliary cams are put out of action and the current is cut off from the ignition plug Thereafter ignition takes place entirely automatically The engine has four cylinders of substantially 5-inch bore and 7⅛ inch stroke, and is claimed to develop 50 horsepower at 1000 r p m The fuel consumption is given as 0 53 pounds per horsepower hour —*Auto Ind*, 50 10

Saving Helium for Dirigibles.—Since airships were first flown one of the difficulties encountered by every pilot has been that of keeping his ship at or near static equilibrium or at a constant altitude. As fuel was burnt out the ship grew lighter in weight and tended to rise This rise caused the gas in the cells to expand and sooner or later it was necessary to release gas in order to bring the lift of the contained gas back to equality with the weight of the ship. Pure gasoline consists entirely of hydrogen and carbon in several related combinations, but when it is burned, either in an engine or as a flame, the carbon combines with some of the oxygen of the air to form carbondioxide and the hydrogen, taking the other part of the oxygen, forms water This water is at first in the form of a super heated steam but quickly cools and appears as droplets of hot water on the walls of any long exhaust pipes On any very cold morning you may see its white plume at the exhaust of every automobile muffler The Navy has developed a method of condensing this vapor and thus obviating the necessity of continually valving off gas in order to compensate for decreased weight due to consumed gasoline. This apparatus occupies a space above the car which is roughly a five foot cube It consists of many small aluminum tubes in which the exhaust gases are to be cooled and gradually give up the water which they contain. Running into a sump in the car this water will be pumped up into the ballast bags in the keel and thus balance the loss of weight due to the burning out of fuel The exhaust of a gasoline engine, in other words, discharges about 1 4 pounds of water for each pound of gasoline consumed.—*U S Air Services*, 9 3, 2 pp.

Metallurgy

Oxygen-enriched Air in Metallurgical Work.—The first serious attempt to use enriched air in metallurgical work was that made by the Belgians at Liége in their small iron blast furnace. While the detailed results of these experiments were not made available to the general public, and the outbreak of the war put an end to the experiments, nevertheless a certain amount of information is at hand. The slightest introduction of oxygen into the air blast made itself felt, a fraction of 1 per cent overcoming detrimental effect of the moisture of the atmosphere. An increase of oxygen content from the normal 20 per cent up to approximately 24 or 25 per cent made it possible to dispense with the hot-blast stoves and produced a higher grade iron. The second comprehensive experiment in the use of oxygen in large-scale metallurgy took place some years ago just over the boundary line, in

Canada It was an attempt made by a well known iron metallurgist of this country to produce ferrosilicon of high silicon content in a shaft furnace A prominent metallurgist states that he does not believe the use of oxygen is suddenly going to revolutionize metallurgical practice *We are going to take* standardized apparatus well known as to peculiarities and of which we are completely informed as to constants, and slowly and carefully and step by step through the introduction of oxygen build up a set of experimental data, revising our equipment as to details on the basis of our new knowledge and, without appreciable break from sequence, develop from our present to the new practice There is, however, one important possibility in the metallurgy of the non ferrous metals that must not be overlooked and that is in the preliminary roasting operations It is believed that the judicious use of enriched air in roasting will greatly simplify the operation It will suddenly lower the grade of self roasting ores thereby eliminating the use of external fuel, and *should at the same time yield a more com*pletely dead roasted product.—*Iron Age*, 113 12, 1 p

A New Process for the Production of Sponge Iron has been developed by the Department of the Interior, in cooperation with the University of Washington, as the result of experimental work conducted during the past three years at the Northwest experiment station of the Bureau of Mines Seattle, Wash. Sponge iron, because of its porous structure and consequent exposure of an extremely large surface of metallic iron, is especially adaptable to the precipitation of copper, lead, and other metals from their solution The development of a process by which sponge iron may be made cheaply from iron ore and low grade coal and afterwards converted into iron and steel products by treatment in the electric furnace would be of especial economic importance to the Pacific Coast region of the United States, a territory remote from the larger iron and steel producing centers, but endowed with cheap electric energy to take the place of the expensive coke that would otherwise have to be utilized in iron and steel production On account of the removal of oxygen from iron oxide ore the structure of sponge iron is very porous, an extremely large surface of metallic iron being exposed As a result, sponge iron is an active reducing agent and precipitates metals from solution with greater speed than do the more massive forms of iron, such as steel scrap and iron turnings. The Bureau of Mines considers that sponge iron will probably be used extensively for the precipitation of copper, lead, and other metals from hydrometallurgic solutions. The many advantages afforded by the use of sponge iron for this purpose should cause an expansion of processes involving leaching and precipitation In the process developed by the Bureau of Mines and University of Washington investigators almost any type of iron ore is satisfactory for the production of sponge iron Experiments conducted showed that similar results are obtained with magnetite hard and soft hematite limonite and sintered hematite It is probable that sponge iron will be made from such by product materials as flue dust pyrite cinder, various slags of high iron content, and iron oxide sludge The Bureau of Mines process consists in passing a mixture of iron ore and coal through a rotating kiln heated at one end to a temperature sufficient to convert iron oxide to metallic iron discharging, cooling and separating the sponge iron from the residual coke and siliceous material on a magnetic separator Details of these experiments are given in Serial 2578 which may be obtained from the Department of the Interior Bureau of Mines, Washington, D C

Two New Alloys have been introduced in aircraft engine construction by the Engineering Division of the Air Service, Mc Cook Field. One is a light structural alloy containing 93 per cent magnesium, 5 per cent aluminum and 2 per cent zinc, and is used for the crankcase of a W type aircraft engine, resulting in a saving in weight of something like 200 pounds as compared with the aluminum alloy containing 8 per cent of copper, which was previously used. The other alloy consists of aluminum, copper nickel and magnesium, and while the formula is not new, being of the duralumin class, the heat treatment has been improved and increased mechanical qualities secured as a result. One of the valuable properties of this alloy is said to be that it retains its

strength at high temperatures, which is of value because it is used principally for such parts as engine cylinders, pistons, cylinder heads and manifolds.—*Auto Ind*

Vanadium is one of the most useful of the rare metals, states J E. Conley in Bulletin 212 recently published through the Bureau of Mines The chief deposits of vanadium, by far the most important in the world, are at Minasragra, Peru In the United States the largest deposits are in San Miguel County, southwestern Colorado From 200,000 to 300 000 pounds of vanadic oxide is probably produced annually as a by product in the extraction of radium Vanadium is used chiefly in steel for purposes requiring great toughness and torsional strength, such as automobile parts gears, piston rods, tubes boiler plates, transmission shafts, bolts, gun barrel, gun shields, and forgings that have to withstand heavy wear and tear The vanadium content of such steels ranges from 0 1 to 0 4 per cent. Vanadium is also used occasionally in certain tungsten alloys for making high-speed tool steel as the introduction of a small proportion of vanadium reduces the proportion of tungsten required to give the alloys the desired hardness and toughness Vanadium differs from tungsten in having a beneficial effect not only on tool steel, but also on structural steel It has been shown that vanadium does not form a double carbide with iron, but gradually takes the carbon from the carbide of iron until iron carbide can not exist if 5 per cent of vanadium is present, and only a vanadium carbide containing 15 per cent of carbon, is present, this constituent is constant at least in tool steels containing 5 to 14 per cent of vanadium Chrome-vanadium steels and chrome-vanadium molybdenum steels are the latest development in structural alloy steels that have gained an extensive market. Almost all these steels are made in the open hearth furnace, chromium and vanadium alloys being added shortly before casting In their physical properties these steels are much like chrome nickel steels, but they have a greater construction of area for a given limit. Most of the chromium vanadium steels made go into automobiles Some manufacturers prefer them because of their greater freedom from the surface imperfections notably seams which the steels that contain nickel are likely to have Some chromium vanadium steel which is not face hardened but has high resistance imparted by heat treatment is used in armor plate of medium thickness

Mining

Is the Coal Mining Industry Efficient? — As a rule the miner does not confine his efforts exclusively to shoveling coal While he should be an adept in the use of the shovel, necessity demands that between filling successive cars he vary his labor Thus he drills holes, charges them with explosive picks down coal sets props and gobs refuse. This variation in employment materially relieves his muscles and gives him a diversity of occupation to vary the monotony of shoveling The miner and the management in most mines and this applies to company or daymen as well as to those working on tonnage—cooperate less effectively than in most other industries The miner fails to receive the necessary cars in which to load his coal The men upon whose labor the miner depends fail to co ordinate their work with his Supplies are not furnished him as needed No instructions are given him to assist him in performing his work, nor—and this is of even greater importance—is any analysis made of conditions and methods to find out how his work can be made as easy as possible Left thus without support the miner is rendered irritable Beyond question this lack of coordination is one of the major reasons why the miner is habitually dissatisfied with his life A miner may readily lose from one fifth to one third of his daily earnings through failure of the management to supply a needed mine car These are some of numerous reasons given for the high cost to the user in a report on "Underground Management in Bituminous Mines" made to the U S Coal Com

Economic Utilization of the Lignites of the Northwest, which comprises nearly one-third of the total solid fuel resources of the United States, depends upon the devising of methods for the production of a maximum yield of solid salable fuel at low cost rather than on the obtaining of long lists of by products which unduly optimistic promoters have emphasized, states W W Odell, fuel engineer, Department of the Interior, in a report just made to the Bureau of Mines. Mr Odell's conclusions are based on the present state of industrialization of the great lignite producing States, North and South Dakota and Montana, which would not provide a market for the gas and other by products obtained in the treating of the lignite It is believed that the lignite carbonizer recently designed by the Bureau of Mines fulfils the requirements of the situation, producing at low cost a fuel, in the form of lignite char, which has a heating value equal to the fine sizes of commercial anthracite and which can be briquetted and compete with domestic sizes. Lignite contains more than 30 per cent of moisture exclusive of the water of decomposition formed when it is carbonized or burned The heating value is approximately half that of good quality bituminous coal. Various processes have been proposed for treating lignite, some of which, it is claimed, will permit the recovery of a large yield of valuable by products. Some promoters have gone so far as to promise the recovery of perfumes, dyes and medicinal products, and they bolster their claims by drawing attention to what is being done with tar of various sorts in distant lands. To date these processes exist on paper only It is a well known fact that carbonaceous materials, such as wood, lignite coal or the like, will yield upon carbonization, a small percentage of condensable products—chiefly water and tar The nature of the tars so prepared and the percentage yield is dependent to a certain extent upon the method of carbonizing and upon the temperature employed This affords a fertile field, for promoters with a vivid imagination to work in The Dakotas, where much of the lignite of the Northwest is found, are, however, sparsely settled and relatively undeveloped industrially hence a high value cannot be placed upon the by products, gas, tar, and ammonia or upon the tar distillation products since they are remote from market There are no refineries in the Northwest for handling or 'working up' special products from lignite tar Further more lignite tar is not the same as coal tar, and therefore the crude products from the distillation of the former are not necessarily identical with those from coal tar Uses for lignite tar in large quantities at a price higher than its fuel value are yet to be found In Europe some of the brown coals are of such a nature that they can be commercially briquetted without a binder after crushing and drying the raw fuel to a moisture content of approximately 12 per cent The lignite found in the Northwest does not readily lend itself to treatment in this manner

A New Coal Mining Method.—The coal strip pit operator is taking a leaf from the ice harvesters book He is "sawing" up his coal into long panels, 12 feet wide so that a few pop shots will loosen it in big lumps for easy and economical loading This reduces labor and powder costs and saves time It increases the value of the coal because the fuel comes cleaner and with less slack. It also improves strip-pit practice in a variety of other ways. All this is directly creditable to the adaptability of a type of underground longwall coal cutter for open cut mining The machine, instead of lying in its normal horizontal position with its cutter bar extending outward, as for an undercut, is turned up on its edge with the cutter bar extending downward Thus the machine performs the function of the ice harvester's cross-cut saw This new coal cutter is a longwall machine, turned up on its side, and mounted on a steel shoe or skid. When moving from place to place, the cutter bar is locked in line with the body of the machine The lines to be cut are laid off lengthwise of the pit, and a hole is bored every 50 feet ahead of the machine. In these holes pins are inserted, to which the feed chain is secured The machine pulls itself along the chain on its skid, making a straight cut the full depth of the seam. Two men, a runner ,and a helper, handle the cutter The helper's chief duty is to shovel the cuttings away from the channel. In a pit which is 50 feet wide, four channels each 150 feet long are cut by the machine 12 feet apart, and the machine handles the 600 feet of cutting readily in an eight-hour shift. It is thus able to keep well ahead of the loading shovel. Two holes are drilled in each 12-foot block of coal, three to four feet in

(*Continued on page 462*)

"Look, it glistens.
Hold it, it's heavy. Tap it, it rings."

YOU tell fine glass with your eyes, hands, and ears In the light the bowl glistens with the rainbow's colors In your hand it is heavier than the common glass bowl When you strike it, you hear a clear, bell-like ring

Lead, that dull, unattractive metal, is responsible for the brilliance of fine glass Because the lead used in making the glass gives it the density necessary to bend or reflect light rays, the glass has the lustre and color that cheaper glass does not have

Lead makes glass heavy

Lead also gives weight to glass The piece of fine plain glass and cut-glass you pick up may be anywhere from 20% to 60% lead Table glass, such as tumblers and goblets, is from 20% to 40% lead When it is struck, lead glass in most forms gives forth a musical ring that ordinary glass does not

Lead also gives the glass a softness that makes cutting and engraving easier and more economical Despite this softness—because of it, in fact—lead glass retains its strength and offers greater resistance to changes of temperature than ordinary glass

How lead gets into glass

To say that the glassmaker gets beauty by mixing lead and some other materials sounds almost magical Yet from the same lead that is used for water pipes he gets two powders, red-lead and litharge, by melting the metallic lead in furnaces where the molten lead is exposed to currents of hot air He takes either the red-lead, or the litharge, and mixes it with silica sand, potash, saltpetre and other chemicals Then he melts these all together and obtains the liquid glass from which various kinds of glassware are molded or blown

One glass manufacturer in a year used 200,000 pounds of lead The entire glass industry takes about 14,000,000 pounds of the annual lead production in the United States

Lead makes glass an object of beauty and admiration Both at home and on the street, lead, in spectacle and reading-glass lenses aids the vision of many thousands

Under the lead-glass lens of the microscope the scientist segregates the germs that may cause sickness and perhaps death

The astronomer searches the Milky Way with the powerful lead-glass lens of his telescope The chemist and the biologist invoke the aid of the microscopic lens in which is lead The photographer and the motion picture operator with their camera lenses containing lead record the pictorial history of the world

In the millions of buildings that are lighted by electricity, lead in electric light bulbs is helping to make night as much like day as possible The glass used in other ways for illuminating purposes is also generally lead-glass

Lead as paint

LEAD in glass is very bashful and conceals itself so that there is no visible sign of its presence But in its more general use as paint, you can see it on every hand As white-lead mixed with pure linseed oil it protects such surfaces as wood from rot and decay As red-lead it prevents rust from eating into and destroying iron and steel

For generations the professional painter has used white lead to save the surface From our forefathers' time it has always been the standard for surface protection Today owners everywhere realize that it is more economical to cover their property with "lead in oil" than to pay for the damage that the weather can soon do to unpainted surfaces They believe in the phrase, "Save the surface and you save all"

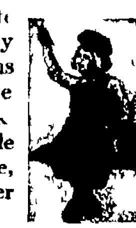
Producers of lead products

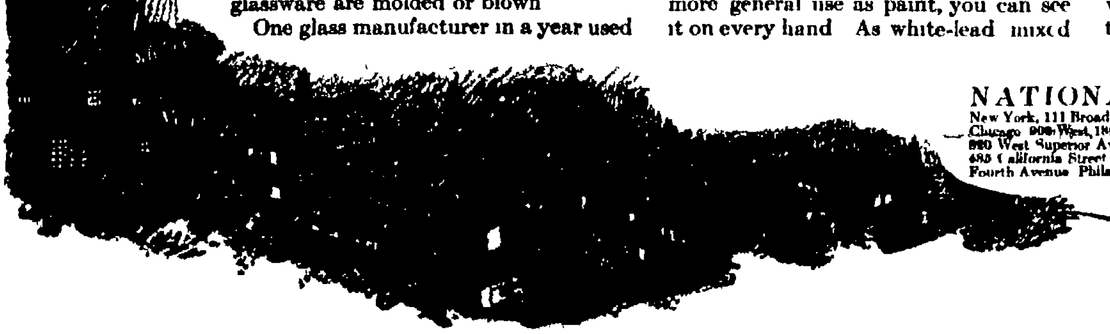
Dutch Boy white-lead is the name of the pure white lead made and sold by National Lead Company On every keg of *Dutch Boy white-lead* is reproduced the picture of the Dutch Boy Painter shown below This trade-mark guarantees a product of the highest quality

Dutch Boy products also include red-lead, linseed oil flatting oil, babbitt metals and solder

National Lead Company also makes lead products for practically every purpose to which lead can be put in art, industry and daily life *If you want information regarding any particular use of lead, write to us*

If you wish to read further about lead, we can tell you of a number of interesting books on the subject The latest and probably most complete story of lead and its many uses is "Lead, the Precious Metal," published by the Century Co, New York Price $3 If you are unable to get it at your bookstore, write the publisher or order through us





NATIONAL LEAD COMPANY

New York, 111 Broadway Boston 131 State Street Buffalo 116 Oak Street Chicago 900 West 18th Street, Cincinnati, 659 Freeman Avenue, Cleveland 820 West Superior Avenue St. Louis, 722 Chestnut Street San Francisco, 485 California Street Pittsburgh, National Lead & Oil Co of Penna. 316 Fourth Avenue Philadelphia John T Lewis & Bros. Co., 437 Chestnut St.

Scientific American Digest

(*Continued from page 420*)

from the free end. These are shot with six ounces of black powder each, the two holes being wired together The longitudinal cuts provide two additional free faces, so that the light powder charge is sufficient to crack off the coal, without materially shattering the lump As a result the percentage of large coal has been increased from 12 to 15 per cent and the cost of powder per ton has been cut in half. One keg of powder now loosens 200 tons of coal, instead of 100 tons, which was all that could be obtained without channeling —*Coal Age*, 25 12, 2 pp, ill

Explosions of Coal Dust such as have caused a toll of hundreds of lives in American mines within the past few months can be greatly minimized by proper rock dusting methods, states the Department of the Interior which recently commissioned George S Rice, Chief Mining Engineer of the Bureau of Mines, to make a study of the use of these methods to prevent the propagation of coal dust explosions in European mines The rock dust is spread upon the floor, roof and sides of passageways or placed upon specially constructed barriers, and when stirred up by the concussion of a local explosion forms a screen which prevents the flame of the explosion from propagating beyond the immediate area of origin Stone dusting as a means of limiting coal dust explosions is made compulsory by governmental regulation, in Great Britain, except in anthracite mines and in bituminous mines that are naturally wet throughout A great many British mines of large capacity have used rock dust for more than ten years The majority of British mines for the past four years and practically all mines for the last two years have been using stone dust. No coal-dust explosions have occurred or have been propagated in any part of a mine that has been thoroughly stone dusted. Although the Bureau of Mines has urgently recommended rock dusting, only a few operators in the United States have adopted the practice Operators of mines in southern Illinois that have installed rock dust barriers state that these have prevented many coal dust explosions from extending beyond the location of the barrier Other operators of mines where disastrous coal dust explosions have occurred in spite of precautions taken to keep coal dust thoroughly dampened, are now considering the adoption of rock dusting The cost of rock dusting in American mines per ton of coal produced is believed to be much less than that of efficient water ing This small cost is a low price for protecting human lives and for insurance against disasters that involve heavy financial losses from the payment of death and injury benefits and through damage to property Results of these investigations are contained in Bulletin 225, copies of which may be obtained from the Department of the Interior, Bureau of Mines, Washington, D C

Electrical Prospecting.—Discovery in Sweden of two new iron and copper sulfide ore fields the deposits in which were totally masked or covered with glacial drift has been accomplished since 1918 by prospecting with electrical apparatus devised by Hans Lundberg and Harry Nathorst These are the Kristineberg and the Bjurfors fields, both in the Skellefteå district, about 450 miles north of Stockholm. The former was found late in 1918, and the latter in the summer of 1922. Since 1918 the method has been tried—successfully it is claimed—by a Swedish company at about sixty different districts in Sweden, Norway, Finland, and Spain Efforts to improve the method have been made by the company, the Swedish Geological Survey, and others. Briefly it consists in observing the distribution of a direct electric current passed through the ground, each of the two contacts with the earth being made with several metallic pegs connected with each other and driven in the ground several meters apart, usually in a circle. Potential differences established in the area between the two circular contacts are determined by means of a movable length of wire having a non polarizing electrode at either end and a galvanometer in between Points of equal potential may thus be located, and when mapped, the resulting configuration of equi potential lines indicates the presence of conducting masses beneath the surface. The work of Lundberg and Nathorst is promising, marking as it does material progress in the science of electrical prospecting. Another recent step has been the extensive experiments of Schlumberger and

Kelly with the "spontaneous polarization" method of the former, which involves the study of electric currents originating in the sulfide orebodies themselves. This method is simple and easily used where conditions are right, but will hardly prove as widely applicable as the other methods discussed which involve the artificial creation of an electrical field.—*Eng and Min Jour Press*

"Stone Dusting," the method employed in British coal mines to prevent the widespreading of mine explosions, has proved more effective than the watering methods relied upon in most of the coal mines of the United States, according to an official mission from Great Britain which is now returning home after having spent several weeks in this country arranging for joint research work with the Bureau of Mines, under a plan officially agreed upon by the British and American Governments. The mission witnessed a series of coal dust explosion tests at the experimental mine of the Bureau of Mines at Bruceton Pa British Silkstone coal dust, similar to Pittsburgh coal dust, was used, and the tests indicated that the British coal dust required about the same amount of inert or rock dust as the Pittsburgh coal dust in order to prevent an explosion from starting, or, if an explosion of firedamp occurred, to prevent the explosion from propagating through the agency of coal dust, this being the cause of all widespread coal mine explosions. Meetings with mining men were held in Pennsylvania, West Virginia, and Illinois at which the members of the British mission explained the method of rock dusting as used in Great Britain, where it is known as "stone dusting," and where some collieries have used it for more than twelve years Its use in Great Britain has been compelled by law in all naturally dry mines since 1920 Since that time, there have been no explosions in thoroughly dusted mines Except for a few mines, rock dusting to prevent coal dust explosions has not been used in the United States, although it has been strongly recommended by the Bureau of Mines. Watering or humidifying has been relied upon in the coal mines of this country, but the numerous coal dust explosion disasters of the past two years, some of which have occurred in what were considered well-watered mines, have caused mining men to be suspicious of the efficiency of watering. Bureau of Mines officials state that watering as a general method is a failure and they urgently recommend rock dusting The method has several great advantages It does not have to be applied daily in every part of the mine as watering has to be, the dust is visible and the presence of coal dust can be observed readily, which is not true in a watered mine, and the lightness of color of rock dust suitable for the purpose improves the illumination of the mine passages and so tends to prevent many individual accidents from haulage and dangerous roof conditions. Many kinds of rock dust are suitable for the purpose notably limestone and light-colored clayey shale free from flinty particles which would be unhealthful to breathe. The Bureau of Mines offers to assist mine operators in determining the suitability of material which may be available for the purpose of rock dusting

Mechanical Engineering

Spectral Analysis for Detecting Flaws.—Increasing numbers of industries engaged in the manufacture of metal products are finding a valuable aid in the method of spectral analysis of metals which they use and which has been developed to its present state by the spectroscopy section of the Bureau of Standards. According to W F Meggers, head of this section, this system offers a more convenient and rapid means of detecting impurities in metals than chemical methods Two big New England firms, one engaged in brass and bronze manufactures and the other in silver, are making constant use of a spectrograph, a device which makes this detection of various chemical elements a simple procedure Other firms in Cincinnati, Ohio, and Buffalo, N Y, are using the same development. It was while the Bureau of Standards was engaged in researches in this science that a problem came up. A steamship had been lost by a boiler explosion. In such boilers there had been placed a safety plug which was supposed to melt at a certain temperature forming one of the conditions preceding such an explosive point. The "safety plug" had apparently failed. "Why?" the Bureau was asked. The spectrograph revealed that

plugs which were supposed to be of pure tin contained a trace of lead, zinc, and other metals in some cases. Pure tin melts at a temperature of 232 deg C The presence of lead or zinc or other impurities caused the formation of a compound which required a very high temperature for melting The reason was clear Hence the spectrum analysis had been applied in a rapid and convenient manner, and an optical method could supplant a more complicated chemical test. Other experiments have proved this belief —*American Machinist*

A New Development that has aroused the greatest interest among engineers and shipowners in Europe—is the new Föttinger system which has just been brought to a practical stage by the Vulcan Works at Hamburg It is claimed, perhaps rightly that when a Diesel engine drives a propeller shaft through gearing in the ordinary way this gearing is subjected to shocks which it is impossible entirely to eliminate even if a flexible coupling is provided The arrangement employed by the Vulcan Works is to interpose hydraulic coupling between the engine shaft and the gearwheel The whole of the speed reduction is effected by the gearing and not by the hydraulic coupling which merely serves to give complete elasticity to the drive and thus to prevent any trouble arising in the gearing itself Several other advantages are claimed When maneuvering no compressed air is needed for starting the engine, since it can run light by merely discharging the fluid from the couplings The saving in weight is considerable as compared with the normal drive. The total machinery weight of a 9500-ton cargo ship equipped with two 2000 brake horsepower engines running at 285 revolutions per minute and driving the propeller shaft at 105 revolutions per minute is 717 tons against 1138 tons with direct coupled engines For each Diesel engine there is an ahead and an astern coupling, the former being aft and the latter close to the engine Between them is the pinion driving on the gearwheel on the propeller shaft. The Diesel engine shaft passes through the pinion wheel and is attached to one impeller in the ahead and one in the astern coupling A second impeller in each coupling is keyed on to the shaft of the pinion wheel itself When the engine has a drive in the ahead direction the working fluid which is lubricating oil, is removed from the astern coupling but the ahead coupling is full The reaction of the impeller on the Diesel engine shaft, causes the impeller on the pinion shaft to rotate and thus drives the propeller shaft at practically the same speed, the slip being perhaps 3 or 4 per cent. It is not essential that lubricating oil should be employed as the working medium. In large installations it is proposed to have water for this purpose The efficiency is higher than might be anticipated and amounts to 95 to 96 per cent, according to the tests that have been carried out For this reason it is claimed that the new system is superior to the electric drive where the overall loss is generally in the neighborhood of 12 to 15 per cent.—*Marine Engineer*, 29 3, 2 pp ill

Machine Shop Chips.—Although the production of chips is one of the chief concerns of the management of a machine shop their disposal is ordinarily given but little attention A visitor to a machining plant sees plenty of chips being made, but he usually is not shown what becomes of them. Naturally since the chips are a by product, and a rather undesirable one at that the management is interested merely in getting them out of the way as quickly as possible Large and progressive firms have in many cases built up systems and plants for handling their chips on what might be termed a production basis, just as they do the work that they manufacture. At the plant of a machine tool company in Cincinnati there is a chip handling plant that is quite up to date, and unique in some of its features. The functions of the plant are to remove the oil from the chips, to provide a storage space for each class of scrap and to facilitate shipment of the material. The structure is made of reinforced concrete and there are seven hoppers, each of which contains a different kind of material or grade of chip. The extracted oil is piped to the different oil filters and tanks. This cutting oil can then be used over again, and new oil is added to make up for losses. In addition, an antiseptic is put into the oil for the prevention of skin diseases that the operators of machine tools sometimes contract from cutting oils. The chip house will hold

a little over a carload of each kind of metal cut, and as soon as a carload of any kind has been accumulated it is shipped out. With the plant running at full capacity a carload might be accumulated in a month. A railway car is spotted beneath the hoppers on the track and the chips are dumped into it. What becomes of them after they are placed in the railroad cars is largely a matter of conjecture, as they are sold either to dealers in scrap material or directly to foundries and steel mills which have need for them and means of consuming them after they have been compressed.—*American Machinist*, 60 10, 3 pp, ill

Industrial Progress

Mariemont, an interesting example of modern town planning and development is now under construction just outside Cincinnati, Ohio. The completion of this town will achieve the goal of years of careful thought and planning on the part of Mrs. Mary M. Emery of Cincinnati and Charles J. Livingood, manager of Mrs. Emery's extensive properties. Mrs. Emery is to spend millions for the establishment of this modern community to promote the happiness and contentment of citizens of moderate circumstances and to provide, within their means the conveniences and necessities of life consistent with present-day American standards of living, only a minimum property rental will be charged, which will be just sufficient to pay a moderate return upon the capital invested. The development comprising some 365 acres, will be provided with complete underground utility systems of the most modern and approved types. There will be about 11 miles of improved streets paved in accordance with the best practice. Homes for a population of more than 7000 people will be provided by constructing houses of various kinds, such as apartments group houses, and semi-detached and detached houses. There will be ample opportunity for amusement and recreation, education and worship through the establishment of parks, playgrounds and athletic fields schools and churches. A feature of the town will be its attractive Town Center and Village Green situated at the convergence of several important thoroughfares. About the Town Center there will be numerous public buildings and business establishments including a town hall, library community club house, hotel, theater, post office, bank stores and business offices, and a public market place. Industrial sites with excellent railroad facilities will be available. The industrial area, when completely developed will provide employment for 3,000 to 4,000 workers.—*American City*, 30 3, 5 pp, ill

A New Method of Cleaning Castings, successfully experimented with at the Erie, Pa., foundry of the General Electric Co. was described by Carl B. Lockhart of that plant in a talk before the members of the Pittsburgh Foundrymen's Association. He reported not only a considerable saving in labor but also of time since the method briefly is that employed in hydraulic mining and a casting which would require a day's time of two men to clean by hand has been done, the speaker stated, in 30 to 45 minutes. Dust, that makes cleaning room work so unattractive to the workmen is eliminated and apparently the possibilities of the method have only been scratched. A centrifugal pump boosts the water pressure from 100 pounds to 250 pounds and delivers about 256 gallons per minute. It was necessary to dig a sump and to connect it to the sewer system, to dispose of the excess water. A Monitor turret type nozzle, with three quarter inch tip similar to those used on the decks of fire tugs, was adopted, mounted on a three inch standpipe, the piping from the pump to the nozzle being three inches. The operator stands just outside the room and heavy plate glass windows in the walls just above the nozzles permit him to look into the room to watch the progress of the work. A small one half inch pipe with holes drilled in it is installed just above these windows, so that the operator can wash them off from time to time as they become covered with dirt during the washing operation. All of the waste material is washed down the sewer, which never becomes clogged and the cost of handling is thus eliminated. The sand, gravel and coke which remain behind are used over again. This washing process has eliminated all of the dust usually seen in a cleaning room where large castings are cleaned and makes it a desirable place in which to work.—*Iron Age*, 113 13, 2 pp., ill.

The Criminal as an Inventor

(Continued from page 377)

over the entire sheet. An astounding sight greeted the gaze of the officials, for wherever the man had written in spittle with his pen the words and letters stood out clearly in black and could be read as easily as any other writing

This method is not on the official roster of secret communication methods and it was unknown to our letter inspectors in the late war until a friend of this writer bore the secret to headquarters.

Mention of this affair brings to remembrance the fact that convicts have been master inventors of secret methods of communication and of smuggling, some of their practices and codes being of the most ingenious, complicated and surprising kind But this matter has been treated at length by others and I have not space to go into details here The art of hidden communication reached its height to be sure in the days when talking was forbidden among prisoners.

Another type of invention to which the criminal has devoted unremitting attention for centuries is the secret door or magical cabinet The reader must remember that no castle of old fashioned romance was without the former and that the latter has been widely employed by conjurers and spiritists. Since such products can hardly have had any licit use to begin with, their attribution to criminal origins is almost automatic. A single anecdote will serve to illustrate the uses to which magical cabinets were put

In the fall of 1879 a most distinguished looking gentleman somewhat far advanced down the slide of life, to judge by his snowy hair and silvery beard, arrived at the Hotel Geneve in Naples With him came a battery of large trunks and, what was more to the esthetic eye a most prepossessing damsel—tall and stately and ripe to opulence The gentleman announced that he was English and permitted himself to be called milord though some thought there was a Teuton burr in his consonants. The lady was his niece and occupied a room adjoining that of milord which fact is important to the unfolding drama

The newly arrived couple had no sooner got their trunks opened than two large cabinets appeared in the shape of moderately high desks with drawers below and a tablet above that was pulled down for writing disclosing other smaller compartments and drawers. Whoever has meandered through the neo antique shops must be familiar with these contraptions As soon as these affairs were unpacked, milord pushed one of them through into his niece's room pulled out a small drawer that was fitted with lock and key, passed his arm back until it must have struck the back and then carefully moved the cabinet over with its back against the door connecting the two rooms, which had meantime been closed Going to his own room by way of the hall, he placed his cabinet in a similar position against the door pulled out a drawer corresponding to that he had drawn in the opposite room and made some marking on the door with a pencil This done, he drew his cabinet away again, cut a piece out of the thin panel of the door with an auger and a jigsaw and put his cabinet back into place

A few days later, after the newcomers had satisfied the host of their superior breeding a thing not difficult to do if one have the ready bank notes, the milord Inglese stopped in to visit Amalfi the principal jeweler of the place He went over the jeweler's stock with fat superciliousness and wound up by buying a scarf pin for a thousand francs He paid in cash and asked that the trifle be sent to him at the Hotel Geneve.

A week later he appeared again with a most beautiful jeweled and enameled watch Could Signor Amalfi supply the missing stones and repair the injured enamel? Indeed he could as well as any man on this rich round ball So the watch was left and soon thereafter called for

On the occasion of this third visit, milord looked over a good many precious trifles, bought a bauble or two and remarked casually that his niece had become engaged and that he must go to Paris and buy a string of diamonds, which was to be her gift from him Could Signor Amalfi recommend the best jeweler And Amalfi, quite up to human expectations duly and fluently recommended himself So saying he brought forth from his safe a collar and necklace which had just been bought from the unfortunate Princess di Pasto for a ridiculously small sum The thing was readily worth 600,000 francs. But, under the circumstances, 450,000 would fetch this marvelous creation. Milord examined it critically and went away saying that he would consider He really had fancied something more expensive for his beautiful niece.

Poor Amalfi sat in the brine for several days before milord deigned to put in an appearance again. This time he had made up his mind to take the thing. After all, it was money enough to spend on a woman's throat. But he would have to arrange to bring the money from his bank in Rome. That would take four days So then! Let Amalfi bring the trinket to the Geneve at 11 o'clock on Saturday and all would be well But the whole business must be a secret from the niece She must under no circumstances see the necklace or suspect the jeweler's mission

On Saturday Amalfi appeared and was ushered up to the room of the milord with vast ceremony He found his distinguished client waiting for him They sat down at once and the diamonds were passed over to milord for a last inspection He had them in his hands passing a critical eye upon them, when there came a light tapping on the door and a musical young woman's voice calling "Uncle! Uncle!"

Milord spun about in a twinkling tossed the diamonds and their case into a drawer of the cabinet, beside which he had been sitting, took a key from his pocket, ostentatiously displayed it to Amalfi and locked the drawer

He was none too swift, for the resplendent niece opened the door without further ceremony and came into the room announcing that milord's tailor had been waiting some time in the other room and was fuming

With a wink at the jeweler who bent a favoring eye upon this young charmer, milord remarked that his niece would entertain Signor Amalfi while he went to appease the tailor

The jeweler and the beauty sat and chatted They chatted of this and that They waited They grew a little restless. The lady relieved the situation with slight coquetries which rallied the flagging patience of the jeweler Again they chatted and once more waited At last the girl grew impatient, said that the tailor was an old bore and went to summon her uncle

Signor Amalfi waited alone now He waited an hour Then he summoned the hotel proprietor who assured him that he had seen milord go out with a gentleman and milady soon afterwards, evidently in quest of her uncle Amalfi mentioned the necklace and indicated that he had seen the thing locked into the drawer of the cabinet

The landlord threw up his hands in horror What an absurd fear of Amalfi's! Why these people were finer than spun gold It was the way of great folks like these to be forgetful No doubt milord had gone off on some tangent and his niece was seeking him Let Amalfi contain himself Besides, weren't the diamonds locked in the drawer

Content once more, the jeweler relaxed on a couch and waited, the hours passed, then the day At nightfall he would be put off no longer Let the Englishman like it or not, he would not go home without his diamonds and he must go home He'd break into the cabinet and if milord wished to sue, let him try it.

A poker was procured and the drawer broken open There lay the jewel case, leering open with its satin throat. But the diamonds?

Milord had merely stepped around into his niece's room, pulled out the trick drawer there reached in, taken the diamonds and gone upon his way And the beautiful niece having allowed her dear uncle to catch the boat, hurried after him and took a train going in the opposite direction All her effects and his, excepting some empty trunks had been previously removed and there was nothing by which to trace these cabinet thieves.

Taking the Stenches Out of Industry

(Continued from page 379)

that a cubic foot of the carbon will take up, the distillation temperatures necessary to recover it from the carbon, and like factors. But the largest installation for this purpose handles only about 4,000,000 cubic feet daily where a garbage-reduction plant for a big city would require the handling of twenty five or even a hundred times the volume of gas.

The largest gasoline-recovery plant uses from nine to twelve tons of the carbon in three different absorbers, only two of them working at a time, while a third is being distilled, so really only six or eight tons are actually in use. At that rate, a big garbage

reduction works would need towers containing a good many tons of the cocoanut charcoal, a considerable investment. However Dr Chaney says that when the chemist knows the stench load' factor of this particular nuisance, probably he can so arrange his carbon sponge that smaller quantities of carbon will handle larger volumes of gas being arranged so there is more exposure surface.

The cost of the carbon sponge is not so serious as certain other factors. Once bought it can be used over and over, but if power must be used to force several hundred million feet of garbage gas daily through an absorbing system at high pressure even if it can be done as cheaply as two cents per thousand cubic feet per day the power charges would come to several thousand dollars a day, which is too expensive. Therefore the engineering design must be worked out with a view to keeping the power requirements at a minimum.

The bare suggestion that offensive odors can be eliminated has aroused great interest among manufacturers in the stigmatized industries, indicating a willingness to make their plants inoffensive as soon as science shows how. But at present the chemist, surrounded by eager questioners who want to know what can be done in this case or that asks for more time to get facts like those of the stench load, the power cost of handling gases, the kind and quantity and absorbing capacity of carbon for different purposes and other problems that require further research.

Instead of burning or rendering garbage an Italian scientist, Dr Giuseppe Beccari simply calls microbes to the colors and lets them make an odorless humus for the gardens out of kitchen leavings, stable manure lawn clippings fallen leaves animal carcasses and other wastes found in the garbage can. Fermentation does the work inoffensively. The fats and tankage are lost to be sure but something useful is left nevertheless, where incineration destroys everything.

It is an improvement on the farmer's manure pit and the compost heap in your backyard where you pile grass clippings and leaves to rot. Dr Beccari first worked it out for Italian farmers and the principle was adopted by municipal authorities in that country eight or ten years ago. Coal is too expensive in Italy for either incineration or reduction, and dumping garbage in such a crowded country involves expensive hauling. So the Beccari system successful there is now being demonstrated in France, England and this country.

By this system the garbage carts back up to a Beccari zymothermic cell" and dump their contents until it is filled. This cell is Beccari's invention. It may be any size from one cubic yard up but for city use there is a standard cell about ten feet high and eight by nine feet in width and length built of tight masonry or concrete tightly covered to prevent the escape of odors.

The thing is practically a stove in which garbage burns by fermentation or bacterial action instead of fire. For there is a grate at the bottom upon which the garbage rests and air ducts for the creation of a draft and a short tower corresponding to a chimney. The cells are built in series and after one has been filled and closed the temperature of the garbage rises to between 140 and 160 degrees Fahrenheit, remaining heated for about twenty days, according to the season and weather, and then slowly cooling down. In from 35 to 45 days it is opened. Nothing is left but a moist residue resembling loam which, when dried can be used to enrich garden and farm soils like compost. The carcass of an animal put into one of these cells is reduced to the skeleton, free from flesh and cartilage. Everything in garbage except bones crockery, glass, metal and the like is reduced to this residue which is odorless, and better than compost or manure from pits as a soil enricher because it contains some nitrogen phosphate and potash. The gases generated during the process pass through the tower where there are "baffles" or shelves with layers of absorbing earth and sulfate of iron that catch and fix their volatile nitrogen and ammonia for fertiliser. This escaping gas is made quite odorless. Garbage in these cells has, for test purposes, been inoculated with disease germs as virulent as the anthrax spores, but at the end of twenty days the germs had been utterly destroyed.

Then, there are great things a-doing in the meat packing industry, long infamous in this matter of industrial perfumes, and damned by and large for them.

The other day, a chemical engineer con-

nected with that industry made a prophecy that promises a revolution

He said that within two years every successful meat packing plant of any size would adopt a new process eliminating obnoxious odors, and that the soap-rendering works and garbage disposal plant would soon fall into line behind the packers

It may take more than two years, but otherwise the prophecy seems conservative, for today this process is foremost in the thoughts of packing house people all over the country It is well worth thought, because it promises to cut down to less than one half their present overhead expenses, and give them more high grade products to sell

There is really only one department of a packing establishment that generates offensive odors—the tank house Other departments are preparing food under Government inspection and have the appetizing fragrance of the butcher shop and kitchen The tank house handles what can t be used for food, turning it into soap grease and fertilizer and just to be certain that the soap grease will be made into soap it is generally denatured and made uneatable beforehand

There are four ways a plant engineer once said in which products leave a packing house They go by team by railroad down the sewer—or out through the tank house!'

Butchers admit that this part of the plant has been most neglected, though its odors have been reduced by quick handling of material and constant cleaning in recent years *Nevertheless millions of pounds of good* food have, through neglect, gone to the tank house and the nature of the materials handled together with the method of rendering them with steam, has made bad smells inevitable

Now this new process called 'dry rendering has been developed by Myrick D Harding, superintendent of a big Chicago meat packing establishment and it has led John P Harris a chemical engineer to make the above prophecy

The idea is something like this

Around the ribs of meat animals there is fine fat and tallow, easily rendered for food by cooking in its own juice' in steam jacketed kettles as mother used to 'try out' leaf lard But that is only 15 per cent of the fat in the animal There is a lot more in the trimmings, bones and various parts that do not go into the butcher's meat These have been sent to the tank house and put through a wet rendering" process being cooked with a considerable volume of water in a closed pressure tank Such fats are high in acid strong in flavor and odor and unfit for food The tank water in which they are cooked is heavy with meat solids which are extracted and dried making tankage The odor of tankage is so bad that it is used chiefly for fertilizer though it could be used for stock and poultry food if of a better grade bringing more money to the packer and the farmer

For years packing house men have sought some way to get rid of the tank water, which is blamed for all the stench and waste of the tank house This new dry rendering process handles tank house materials without water It extracts the fat by roasting instead of boiling and changes the odor of the tank house from a fertilizer smell to one of cooking The trimmings bones and other material are first chopped fine in a hashing machine and then cooked in a revolving kiln that keeps them in constant agitation When *sufficiently cooked they go to a per*colating machine the invention of Mr Harding that separates the fat from the 'cracklings" Hitherto it has been impossible to get a satisfactory percentage of fat out of the cracklings by any dry cooking process but this percolator does the work experts say Besides yielding more industrial grease, and a better quality without offensive odors, it leaves cracklings instead of tankage to be ground up into stock and poultry food—a coarse grade of Philadelphia scrapple" for the cows and chickens, as it were

Everything that goes into the melter is fresh and sweet and comes out fresh and sweet Tank house fats rendered by this process, though used only for industrial purposes, are in many cases of food quality And more food fats can be saved from the tank house by dry rendering Besides making better products, and effecting marked economies in labor and fuel, this process makes the tank house a pleasant place to work, where heretofore it has been avoided by everybody in a packing establishment except the folks who had to work there, and they have not always been the best kind of workers because nobody wanted that sort of job if he could hold down a pleasanter one.

Another odor that seems scheduled for

elimination is the "fishy" smell of the fish market, wharf and fishing vessel This has been a handicap for years in the fish dealer's business, turning away customers Popularly, it is a humorous subject, but people in the fish business do not see the joke For landlords refuse to rent property to fish dealers, municipalities banish fish houses to lonely places, and the restrictions and laws imposed upon the industry for its smells have been a serious handicap in its development The fish business in this country is an undernourished infant industry for our per capita consumption of that food is pitifully small And the smell of fish more than any other single factor, is held responsible

Science finds the odor of fish highly interesting

You know of course that when you catch fish yourself, clean them immediately and put them right on the fire, they are not fishy either in smell or flavor You have said "That is because they're fresh" and let it go at that But science says you may have just as good fish devoid of the fishy odor and quite fresh in flavor, days after they have been caught—yes, and weeks if they come out of cold storage—provided you understand what causes the fish odor and get rid of it.

Fish have a natural slime that makes them slippery This is a coating that protects them against bacteria as the skin of an apple protects its flesh from decay molds Small fish caught and thrown back into the water are frequently attacked by diseases because their protective coating has been broken in handling While this slime protects the living fish it is itself inhabited by between 75 and 100 different families of oceanic bacteria about one third of which are comparable with those that cause decay on land in meats and other foods Fish taken from the water will be sterile for 10 or 12 hours Then the slime growing warm, and an excellent culture medium stimulates bacterial growth which penetrates the skin and flesh And there's your fishy smell which isn't characteristic of fish at all but due to bad handling It can be eliminated by butchering cleaning and cooling fish as soon as they are caught

This dovetails right in with an interesting new sales method that has lately sprung up in the fish business Instead of selling fish whole their meat is cut off in boneless filets wrapped in water proof parchment paper and sold ready for cooking These filets are so devoid of odor that they can be kept in a grocer's ice box with butter and the butcher and grocer are able to sell fish giving wider distribution If a housewife wants boiled fish she can cook it right in the parchment paper and nobody will know she is going to have fish for dinner

There is another way to get rid of the fishy smell in markets on wharves and particularly in fishing vessels The odor of a well seasoned fishing vessel tumbling around out at sea doesn't bother people on shore but it is something that fishermen have had to put up with for hundreds of years

"When it is going full blast" says Captain Frederick William Wallace the sea novelist "it will blacken white paint make a lamp flame turn blue and discolor rubber boots I could write a monograph on bilge perfumes I've sniffed *eau de bilge* on the halibuters and trawlers of the North Pacific, the shackers haddockers and steam trawlers of the North Atlantic the red snapper smacks of the Gulf and a few others In some craft it is strong enough to make a skunk die of vexation at being unable to surpass it or make a shark cough or turn the stomach of an ostrich

To get rid of this odor fishermen rip up decks take ballast out and scrub it with lime, lime wash the hold and have a sweet ship for one out going voyage but as soon as fish are caught again, the bilge begins to get foul.

Besides writing novels Captain Wallace edits a fishermen's trade journal and not long ago set out to see what Science could do to deodorize the fish industry He sent out a chemical engineer M M Stone, with one of his sub-editors to make a study of bilge water in the fishing vessels that come into Boston harbor Samples of bilge water were taken allowed to age several days examined and found to contain organic matter in suspension that gave off sulfuretted hydrogen—which is the odor of a bad egg What Captain Wallace said about white paint was confirmed chemically for white paint contains white lead, and that is soon blackened by sulfuretted hydrogen The chemist then made experiments with differ

(*Continued on page 433*)

Radio Notes

Lightning and the Antenna.—Another fall, winter and good part of the spring have rolled by and we are back to summer days and electric storms, which are the curse of radio At the first signs of warm weather many radio enthusiasts proceed to take down their antennæ, for fear of the lightning hazard Yet according to Dr J H. Dellinger, chief of the radio laboratory of the Bureau of Standards the lightning hazard is practically nil Only for outside" antenna need lightning protection be considered at all he says. It is very simple A small and cheap device called a lightning arrester should be connected between the antenna and the ground wire on receiving sets An antenna is no more likely to bring lightning into a house or apartment than are overhead telephone or electric light wires The principal hazard from antennæ is from stringing outdoor antennæ over or near electric light wires A number of persons have met death by electrocution from this cause."

Convenient Power for the Radio Receiver is now available in the recently introduced 'Unipower' unit of a well known storage battery manufacturer This unit combines a special form of chemical recharger with the usual storage batteries for the filament and the plate circuits of the receiving set. The unit is permanently connected with the electric light socket, so that it is self-charging and will "float in on the line and the radio listener may use the lighting current direct so to speak, properly rectified and reduced to the required voltages The Unipower unit is kept at full potential by fresh current coming in as fast as the set uses it up Thus an owner may operate twenty four hours a day if he wishes. No battery crackling buzzing or fading out such as occur when batteries are just too good to throw away is experienced The receiving set is always maintained at its utmost efficiency so far as the battery current is concerned The new unit will last for years, according to the manufacturer It comes in a heavy oak case with connections grouped in a compact plate at one side

Spark Interference comes up for discussion in the April issue of *Radio Broadcast* We are told that the troublesome spark signals should not be so disturbing to us because a 500 kilocycle signal (600 meters wave length) is far enough away from most broadcast frequencies so that but little interference should be experienced except by those who are very near the spark station But most of the trouble does not come from this spark signal frequency For some reason better known to others than to us many spark sets near New York Harbor are operated on a frequency of 666 kilocycle (450 meters), right in the middle of the broadcast band At a recent meeting of radio experts in New York representing the U S Department of Commerce the Canadian Government and the commercial radio companies, it was agreed that spark transmission should be done away with as soon as practicable (perhaps within a year) and that the 666-kilocycle frequency should not be used at all by ships in American waters. This is a most admirable achievement and we are sure the radio public is much indebted to those responsible for the inauguration of this change in ship radio traffic

The Sodion Tube, cleverly called "The Golden Rule Tube because it cannot be made to oscillate and thus interfere with the radio reception of others is coming more and more into use. It is quite different from the usual vacuum tube, although it is also a three-element tube The sodion does not have a grid or control electrode interposed between the filament and the plate Its name is derived from the fact that it utilizes some unusual properties of an alkali, such as sodium, and operates through the flow and control of ions. The input circuit of the sodium is connected between an electrode called the "collector" which corresponds to the grid of the ordinary tube, and which is bent into a U-shaped plate that partially surrounds the filament with its open side toward the anode or plate. The output circuit contains the usual head telephones or transformer primary and "B" batteries and runs from this plate or anode to the filament. The output of the sodion is a varying plate current. In addition to the collector and anode members, the sodion tube contains a non inductive heater coil which is in series with the filament and is entirely enclosed between the tube and an outer glass envelope

Is the Antenna Doomed?—Many of the latest radio sets now reaching the public

are of the loop type. What with the simplification of the Armstrong super-heterodyne circuit, as well as the development of radio-frequency circuits and reflex circuits, it becomes possible to produce compact sets which operate on small loops. No factor has had a greater influence on this move than the dry battery tube, which makes possible the use of four, five or six tubes with a few dry cells for the filament current. Not long ago the writer of these lines attended the demonstration of one of the Armstrong super-heterodyne receivers. This particular receiver has a small, oblong loop inside the long cabinet, the latter being provided with a handle so that it can be carried about. Although the demonstration was held in the steel encased Woolworth Building, loud and clear radio concerts were intercepted from the local stations and even from a station in Philadelphia It is positively uncanny, this business of carrying a radio set about a room, while a concert comes out of the loud-speaker Because of the directional characteristic of the loop, these loop sets provide additional selectivity, which is very desirable in these days of heavy radio traffic.

The Life of the B Battery depends on the following important factors, according to G C Furness, an authority on the subject 1.—The quality of the cells in the battery Each B battery consists of an assembly of a number of identical cells, each cell giving 1½ volts. Fifteen cells are used in a 22½-volt battery, 30 in a 45-volt battery Before a good B battery can be made a good dry cell must be made, and that is no easy task 2—The size of the cells used in the battery The larger the cells the more electrical energy they contain, and the longer they last Size should be proportionate to use. 3—The amount of current taken from the B battery by the tube or tubes. Obviously the greater the current the shorter the life of the battery 4—The amount of daily use of the receiving set. Again, obviously, the greater the number of hours the set is in use each day, the fewer days will the battery last. 5—The 'cut-off" voltage As any battery is used its voltage gradually drops until a point is reached at which operation is unsatisfactory That is the "cut-off" voltage, the lowest voltage at which the set gives satisfactory results The lower this voltage the longer the life of the battery 6—The age of the B battery when put into service All dry batteries lose energy when standing idle, some of them at a quicker rate than others. 7—The personal factor that determines, not the life of the B battery, but how long you will use it, is your opinion as to when the concerts are too weak.

Vacuum Tubes in the Making.—Tube making requires great care and patience. There are thirteen steps or processes in production, all of which must be watched closely in order to assure a perfect finished product. A test is made after each step is completed and, of course, a test after the tube is complete The manufacture of a tube is begun by spinning a flare on the end of a short glass tube. This tube is then called the "flare." Five wires are then inserted in the "flare" Looking at a WD-11 one can see five wires in the inner unit, although there are but four contacts at the base The fifth wire is a blind insert to support the plate. The end of the "flare" is melted and pinched to imbed the five wires securely This is now called the "press." The five wires are next cut to their proper lengths and the elements spot welded in place by expert girl operators. The filament used in the WD-11 is a platinum iridium alloy coated with chemicals to increase the electronic emission Now a small hole is melted into the glass "blank" or bulb of the tube to be, and a thin tube fused on its end The "press" is then sealed to the bottom of this "blank" by welding with a gas flame All air is then exhausted from the 'blank' through the thin tube This is done by inserting the glass tube into a piece of rubber tubing which in turn is connected to an exhaust pump. Before the pumps are turned on, a covering which serves as an oven is pulled down over the tubes and they are subjected to a temperature of 400 degrees Centigrade to drive all gases from the glass walls and metal parts. While the exhausting is going on the plates are heated red hot to remove the gases from the metal plates and supports. The pumps are turned off and a gas flame run around the bottom of the long glass tube until it melts off and forms the tip of the vacuum tube. The tube is now complete except for the base which is baked on by machine, the tips neatly soldered, and

the tubes tested under conditions similar to actual receiving.

Man-Made Static.—With the extensive use of super sensitive radio receivers, radio listeners are more and more subject to all kinds of disturbances which heretofore, because of the relatively insensitive circuits in use would have passed unnoticed. Thus our super sensitive radio receivers now pick up the make and break effect in an electric light circuit, the arcing of the trolley-car wheel on the trolley wire, the leakage from a faulty power transformer, the vibrating reed of the storage battery recharger, and so on Although the electrified railroad is almost a mile distant, the writer of these lines has noticed an overwhelming avalanche of man made static when sleet forms on the third rail and causes improper contact between rail and contact shoes. The writer has found it impossible to operate his set when an automatic traffic lamp at the other end of the town, was not functioning properly Indeed, radio in the town was entirely demoralized until the source of the trouble was located and rectified Old timers who can recall the days of the cumbersome tuning coil and the troublesome crystal detector, will tell you that they never heard such static back in the pioneer days The truth of the matter is that there were just as many causes for static disturbance as today but the relatively insensitive receivers of those days never picked up such minute electromagnetic disturbances It was only when an electric storm hove into view generally speaking that heavy static disturbances were recorded All of which causes us to wonder whether after all the development of the super sensitive receiver is the best procedure for the future of radio broadcasting The more sensitive the receiver the greater the 'parasites' or extraneous electromagnetic wave disturbances After all is said and done the real solution of better broadcasting lies in more powerful broadcast transmitters brought nearer to the radio audience by a vast system of repeater stations.

The Case for the Regenerative Receiver is again presented this time by that well known radio engineer and manufacturer Mr C D Tuska of Hartford Conn "Radiation from receiving sets, a brand new type of interference,' states Mr Tuska 'is creeping out and is becoming very serious Probably 90 per cent of the present receiver interference is due to improper and careless operation Radiation from a receiving set improperly handled is the cause of squeals and howls in other receivers in the neighborhood In general all present day receivers (regenerative radio frequency and most of the dynes) have at least two control knobs One of these knobs generally covers wave lengths while the other no matter what it is labeled, covers regeneration Regeneration is the building up reinforcing, or amplifying of received signals within the vacuum tubes Regeneration carried too far causes the vacuum tube to sustain these amplified or reinforced signals and results in the generation of radio frequency currents This is called oscillation Regeneration up to the point of oscillation, will never cause any interference What happens is that the regeneration is carried a few steps too far and the receiving tube starts to radiate waves corresponding to the length at which the tuning controls are set The receiving set becomes a transmitting outfit. How to make a novice distinguish between regeneration and oscillation is not an obvious affair I would recommend that those of you who have receiving sets and do not know take this suggestion and try it out on your own set Set the wave length dial and bring the regeneration up from the zero to the maximum position As the regeneration is increased using the right hand to turn the control, tap the wire leading to the grid of the detector with the left hand When the tube is exceeding the regenerative point and has broken into oscillation you will hear a click or two clicks as you tap the grid connection. Sometimes you can get the same effect by tapping the aerial binding post, but the grid is the only reliable contact. Tune your set with both hands at one time. With the left hand turn the wave length control a degree or two and then use the other dial (regeneration) with the right hand, carefully bringing up this dial to the critical point of 'maximum regeneration' This point may easily be distinguished after a little experience by the nature of the sounds in your loud speaker or phones. If you have gone too far in regeneration, the received signals will sound mushy Back down the regeneration dial. Then leave it alone"

Taking the Stenches Out of Industry

(*Continued from page 420*)

ent deodorants, and found that hypochlorite of soda, made by electrically decomposing salt brine, would turn a fishing vessel sweet and clean, and keep it so This chemical is cheap, non poisonous, and can be made on fishing vessels with fairly simple apparatus. When enough of it is dissolved in a fishing vessel's bilges, they are completely deodorized and become fairly clear A ship can be kept sweet without tearing up decks removing ballast, whitewashing or any of the other expensive measures formerly necessary, for whenever *eau de bilge* develops it can be eliminated with more of this chemical Fish odors around markets, piers and storage places are eliminated by using it as a spray or in the cleaning water

Industrial smells are bad business They create public resentment, bringing the health authorities down upon the offending industry with hampering restrictions and stigmatize it as a nuisance And the food industries having had more than their share of offensive smells, have also suffered from popular suspicion

Therefore, now that ways are being found to take the perfume out of industry there will be little delay in applying them The manufacturer is just as keen about it as the community For where the latter suffers chiefly in its sense of smell, he has been suffering in his pocketbook.

Telepathy and Radio

(*Continued from page 382*)

choice of the reading and one might imagine that it would be free from any psychological dictation of the answer The returns contradict the latter supposition, however 49 answers out of 473 hit upon the hours of three or four o'clock, while 9 45 and nine o clock scored eleven each Perhaps the psychologist will analyze this and tell us just why the preferences indicated are shown The correct hour of 1 10, by the way, was given by three people while it may or may not be significant that the respondent who had more correct replies than *any other came very close here* naming the hour of 1 15

No less than 94 answers involved readings that were not even multiples of the five minute unit. This would have embarrassed us if we had felt obliged to calculate the mathematical probabilities since in the one event there are 720 possible answers and in the other only 144 Until better data are available, perhaps the psychologist will consider that this test indicates that when asked to name an hour at random 25 per cent of the human race will name an even hour 30 per cent additional an even quarter or half hour, 25 per cent more an exact multiple of five minutes, and the remaining 20 per cent an odd minute One faithful soul even split his minutes and reported 8.47½

Keys—and Other Things

The sixth test involved identification of a specific object which I held in my hand and which was described in no further detail than that. Three people out of 461 correctly named it as a key No calculation of probabilities is possible for we don t know how many different objects might have been named, and we couldn t weigh the psychological factors very accurately That these were large is proved by the fact that about 200 people named an object that consciously or subconsciously, was suggested to them by the idea that I had got it out of my pocket as I spoke. There were 55 pencils 37 watches 34 pocket knives 22 coins of one sort or another, 21 fountain pens Outside the group of pocket pieces the most popular guesses were a book (40) an apple (29), a ball or something else involving the idea of sphericity (17), a block cube square piece of wood, etc. (13) a paperweight (12), a hat (11), a stone (10), an orange (10) In all, eighty different objects were mentioned A number of people were, consciously or otherwise, trying to outguess me with such selections as a cabbage a doll, a flower pot, etc. *The two who said a silo and a cow had* not, presumably, heard me say that I held the object in my hand.

Test No 7 was based upon an advertisement from the Sunday paper, the identification of the product was asked, by kind rather than by specific trade name Of 459 replies, 14 named the article correctly as a dentifrice. Now tooth pastes are advertised, but not nearly so freely as automobiles and a lot of other things—and one whose mind turned toward the bathroom would, I think, strike on the soap first I should have been prepared to find considerably less hits here Still, 14 of my audience may have just been brushing their teeth! Perhaps we may say of this test, alone that it makes it difficult to conclude with certainty that telepathy was not at work

The final number on the program was a very dramatic picture of a cross-country run It was described merely as of a sporting *event and the audience were asked for fur*ther details Of 465 replies, nine indicated a foot race or even a cross country run and six others said just a race without indicating whether they had men or horses in mind Baseball golf and boxing got a heavy preponderance of the votes indicating that this test was largely answered on psychological grounds dictated by personal interest and the season Devotees of mah jong will perhaps be gratified that in the opinion of several members of the radio audience, this pastime qualifies as a sporting event.

The Critical Test

The fifth test will take a lot of discussion For it, as nearly as I can reproduce the exact words, the announcement was

On the next test I must give you a little more time and I must take a little more myself to explain what is wanted You will recall that when you were very young you used to draw human figures in simple outline—a circle for the head an ellipse for the body four straight or bent lines for arms and legs We have before us in the studio four sketches of this character each engaged in some definite action or standing in some definite position These actions and positions are such as can be easily drawn easily recognized and easily described Please try to *reproduce the four sketches or write down* words indicating what they represent '

In drawing the originals during an idle moment of the afternoon I had set them rapidly down in a row without any partic*ular mental effort—just letting them flow off* my pencil as they flowed into my mind They represented in order a man waving a flag running standing on his head and kicking a football I had intended to tell the audience that they might insert such accessories (flag football etc) as were required by what they had in mind but I refrained from this as being too strongly suggestive Plenty of them did it anyhow

It is important to observe that any argument about the psychological probabilities which we may apply to the returns attaches equally to my originals my mental processes in drawing these were presumably quite the same as those of the non telepathic respondents—who of course constituted a majority at least of my audience

On this test 403 people drew four figures Seven more drew single figures only which were scored as pertaining to test 5A On *this test ten scored successes in whole or* in part Fight people drew a man waving an unmistakable flag—two drawing him first and six in some other rank Two left it doubtful whether it were a flag or something else—a hatchet particularly one of these had him in the right order and one in the wrong For scoring purposes Dr Murphy and I agreed that those who drew the figure correctly but in the wrong order ought to get full credit On 5A we gave half credit for a doubtful flag this made eight successes and two partial successes out of 410 returns—neither positive enough nor negative enough to get excited about

The returns for the other three little figures however were decidedly exciting Of 403 people answering these three no less than 100 drew a man running—27 getting him correctly in second place and 73 in other orders. Of the same 403 people 25 *drew a man standing on his head*—14 correctly in third place 11 in some other place And 25 of them did something with the kicking man We recognized 11 complete successes where the little figure was actually kicking a ball and 14 partial successes where he was just kicking the air Of the 11 four were in order and seven out of the 14, one was in order and 13 out.

Accident, Psychology—or Telepathy?

This raises several critical questions The mere score seems high not alone on the running man, but also on the inverted man and on the kicking man Indeed, looking at the thing psychologically, the running man is perhaps less alarming than the other two When I ask for a man engaged in some definite action, inevitably, I turn my listeners' thoughts away from a man standing still; and if he isn't standing still, what more

natural to think of what more ridiculously easy to draw than a man running? It really seems as though 100 instances of this choice are more to be expected than 25 cases where my listeners give a man on his head, or a man kicking

Then the man on his head gives us another large metaphorical mouthful to chew on On the other three sketches, 119 more or less correct replies included 33 in the right order and 86 in the wrong—a mere 28 per cent being in the right place But on the man upside down no less than 56 per cent *of the correct answers are in the correct order* Can it be possible that this is accident or psychology?

Our first attempt to explain it as psychology seemed rather to make sense We argued substantially to this effect

Confronted with the demand to draw four human figures in action the average person will probably exercise considerable ingenuity and originality on the first one and will then relapse into a quick and easy natural choice on the second Or he will make the quick and easy choice first and the ingenious one second In either event having been natural and drawn a running man and *having been ingenious, and drawn a man* waving a flag or something of comparable unusualness—he will be at a temporary loss for a third alternative and will reach this only after a process of more or less conscious and deliberate search Undertaking this search what more logical or psychological than that he should turn the figure upside down? Certainly having made a choice for three of my originals which falls in with this argument I am in no position to refute it The only refutation—for that matter the only verification—would be in specific tests So Dr Murphy and I individually and collectively attempted a series of tests designed to learn what would be the response of the human animal in general to the demand that he draw four of these little figures

This test was made upon six groups of students in some cases and office workers in others and under conditions that were purposely varied but always with the effort to describe what was wanted in the words I had used in the original radio test The control test was applied in all to 163 persons The variation of conditions had no effect that I can see and for that reason I shorten the discussion by ignoring it ignoring the separate groups tested and giving the results in a lump

Of the 163 subjects only three drew a man waving a flag and all three put him in first place the position he occupied in the original *test* Thirty *four drew a man* running seven putting him in second place as on the radio test while 17 put him in first place That is to say 24 followed the psychological argument advanced to account for the large number of runners of the remaining ten six had the runner third and four had him fourth Only five of the 163 control subjects drew the man on his head one put him in third place as on the radio test two in fourth place one each in first and second place Six drew a man kicking a ball (one in fourth place as over the radio three first, and two third) while six others drew the kicker without the ball (again one in fourth place two first three third)

Test vs Control

Comparing with the radio results we find that 1½ per cent of the radio subjects scored a full success on the flag waver with two per cent scoring some measure of success while of the control subjects two per cent scored a complete success and none a partial one Obviously there is no evidence that the telepathy test brought out any telepathy on this item

Of the radio audience and equally of the test subjects 21 per cent were successful with the running man Six per cent of the radio subjects put him in the same place that I had put him in, and only four per cent of the control subjects followed me here This divergence would be of doubtful significance even if repeated for several tests, on the single test it meant nothing at all Again we have no justification to infer that telepathy was at work

Of the radio audience, six per cent drew a kicking man with about three per cent giving him a ball to kick, while slightly more than one per cent put him in fourth place as I had done Of the control subjects, 7½ per cent drew the kicker and again about half of them gave him a ball to kick, with little more than one per cent placing him fourth So again, significant as it seemed at first glance that this test might be, there is nothing here.

Six per cent of the radio fans drew a man on his head 3½ per cent of them correctly put him in third place. Of the control subjects, only three per cent got him in at all and less than one per cent got him in third place Here we have the one result which makes it possible to suggest that telepathy may have been at work. Of course such an explanation would be hasty from one test, but at least, in this one instance from the twelve there is something left to explain.

Analysis may take one further turn If certain individuals among the audience were displaying any tendency toward telepathy we should expect them to be right, in the long run more often than the bulk of the respondents. We can try this out very nicely by looking at the 41 respondents who got more than one item right or partly right. Did they score more consistently with their second successes than the bulk of the subjects scored with their first and only successes?

To answer this we must have a figure representing the probability of getting each question right and in this, as we have seen *psychological considerations* enter which we cannot evaluate accurately We dodge this by assuming that, *for purposes of dealing with this test*, the correct probability on each question is represented by the performance If 78 of our respondents out of 448 have the *Times* test right we assume that the probabilities of getting it right *for this audience* are 78 in 448 or 1 in 5 74 This puts us on a solid basis

Under this convention since nobody got the first question right the probability of getting it right is zero so we omit it from the argument entirely and proceed as though the remaining eleven items constituted *the entire series*

Let us take the *Times* test again When we know what the separate probabilities are for getting each of the remaining ten tests right we know automatically what the probabilities are for getting each wrong We can calculate from this the chance of getting them *all* wrong But knowing this we know the probability of *not* getting them all wrong—which is to say the probability of getting one (or more) of them right This figure applies equally to those who got the *Times* test right and to those who got it wrong—so far as guessing the answers is concerned But if any or all of those who *got the Times right show a tendency toward* telepathy they ought to better the probability for the remaining tests And the same argument applies with each single test and each residual group of ten other tests. Of those who answer any question correctly we can always say how many ought to be right on something else If performance exceeds these figures we may fairly suspect telepathy of responsibility for the unearned increment

The Final Angle

Of those who got tests 2 3A 3B, 4, 5A 5B 5D 6, 7 or 8 right the table of page 382 *makes it plain that in no single instance* was the percentage scoring a second success greater than the percentage of the general herd who scored a single success in one of the remaining tests Equally for the general case this table shows that those who got anything at all right did not score second successes any more freely than the general herd scored first successes. Indeed, on most of the individual tests and on the general case the group who had got one item right did not even do so well as did the common herd

But to all this there stands one conspicuous exception Of those who got the man-on his head of Test 5C right, only 11 on pure chance were entitled to get anything else right In point of fact, 16 got something else right The slight possible *significance which this single observation* would ordinarily possess is considerably enhanced by the fact that it was this very test which on its own grounds gave us reason for suspecting that telepathy might have been at work. There is absolutely no dependence between examination of the returns in these two ways—absolutely no inherent reason why the test that shows up strongly from the one angle should show up strongly from the other That this test does exactly this is possibly significant, and certainly of extraordinary interest. As regards definite conclusions of course, there is "nothing to say until further tests have been made These will proceed as rapidly as possible some being made as was the first one, with such improvements in tech-

nique as experience suggests, and others being made in a less promiscuous fashion with those of our high scorers from the first test who display willingness to give us a little of their time There are enough who got complete or partial successes on three separate items to make the hunt through the list for real telepathists quite worth while

Coal and Coal Tar

(Continued from page 390)

used in enormous quantities during the war and which is also of some importance as a commercial explosive It forms the starting point for the manufacture of a large number of intermediates which are used in making various dyes and drugs Xylene is also used for similar purposes Naphthalene is the ordinary tar camphor which is used to combat the moth in its depredations on clothing It is also used in preserving hides It is estimated that the potential naphthalene in the coal tars produced in America, is probably far in excess of 100,000,000 pounds a year The crude carbolic oils phenol and the cresols are used for many purposes in preparing disinfectants, sheep dips, flotation oils (oils used in separating the metallic constituents from the gangue in ores) manufacture of synthetic tanning materials dyes perfumes photographic developers explosives pharmaceuticals etc

Anthracene is used as the starting point in making alizarin and vat dyes The pitch that forms the residue is employed in making roofing felts paints as binders in making molds for casting steel and other metals as binders in briquetting coal dust waterproofing dams and concrete in general and for many other purposes In recent years certain of the higher boiling point fractions of coal tar have been utilized for the manufacture of lubricants used as substitutes for mineral lubricating oils and greases The Germans developed this industry during the war when short of mineral lubricants

During the war when the demand for benzene and toluene was very great for the manufacture of military explosives processes for scrubbing these products out of illuminating gas were developed To-day practically all of the benzene and toluene recovered in gas manufacture is scrubbed out of the gas and the tar that is obtained accordingly contains very little of these constituents

It has been shown that coal is burnt in the furnace and stove to produce heat and power No matter what the fuel is, whether it be a liquid or a solid, it must first be converted into the gaseous condition before it can produce heat Thus every kitchen stove or steam furnace is a small gas producer, whose efficiency is low compared with the gas generating apparatus in the gas plant The efficiency of an average steam furnace is only about 50 per cent, while that of a gas generating plant is 85 and even 90 per cent on the thermal basis. The logical conclusion is first to convert the coal into gas at the gas plant and then to burn the gas in the place of coal

The time is undoubtedly coming when coal will be supplanted as the common fuel for the waste in heat and valuable by-products that ensues when it is burnt in the stove, steam furnace or under the power boiler is too great to go on indefinitely What the fuel of the future will be will depend on how economically and efficiently it can be made and distributed from the place of manufacture to the consumers Everything points to gas as the permanent fuel of the future It is possible that the gas will be produced right at the coal mine and distributed through a system of pipe lines much like the present oil pipe lines The coke produced will then be consumed for metallurgical purposes or itself converted into more gas the by-products collected and manufactured into valuable substances and the gas alone used as a fuel

In our country with its large natural resources with its apparently limitless supplies of coal iron and other essential commodities the moment of exhaustion of these supplies seems far in the future But that moment is surely approaching and even now we hear estimates made of the day on which our oil resources will be exhausted It is time now to give a thought to the future Coal will not always be so plentiful and if we have learned anything from our experiences during the past years' coal shortage, we must have formed some idea of a time when there will be no coal and of the dire things that could happen then if we do not prepare now to develop other fuels to take its place

Our Abrams Investigation—IX

(Continued from page 383)

to time to follow the progress of the tests, but no one else saw it until the end

For Series I, Mr Lescarboura served as reagent. While working with the fourth specimen the reactions became tired' and the Series was suspended It was intended to return to it later, but examination of the three sets of readings obtained made it plain that these three specimens must be adjudged identical—if the readings for the remaining specimens did not diverge from these the test would be worse than a failure, in that it would not discriminate at all between the specimens The three specimens thus associated were numbers 1 4 and 5 the identical specimens were 1 2 and 5 The Series was considered as completed and scored as a semi success

For Series II one of the physicians acted as reagent. The readings for specimens 2 and 3 were very closely parallel After some discussion it was decided that of the other four number 4 got closest to these two The identical specimens being as in Series I, Series II was therefore a total failure

After four specimens had been tested in Series III using an attaché of the doctor s office as reagent, the reactions were completely exhausted and the test had to be terminated It was plain that no two of the four specimens tested could be pronounced identical Since the two remaining untested might have come out as identical with any one of these this Series could not be rated at all Its readings however are available for checking against those of Series I and II for which the same specimens were used, and in the second table on page 383 they are displayed and used for that purpose

In Series IV a young lady attendant was the reagent The identical specimens were 3 4 and 5 It was difficult to choose between 2 4 5 and 6 on the basis of the readings obtained the most plausible selection seems to involve the throwing out of the fourth specimen on the ground of the low reading for rate 60 The test then becomes a total failure

Of Series V made with Mr Lescarboura as reagent no three of the specimens stand out as in any way probably identical and attempting to force a choice the physicians could reach no agreement as between the three combinations 1 4 5 2, 3 4 3 4 6 Two of these combinations are wholly wrong and one partly wrong the identical specimens were 1 3 6 Combined with the obvious failure of the test to make a clear distinction this seems to warrant the verdict of total failure for Series V

Series VI one of the physicians as reagent points fairly straight to specimens 1 2 5 as the identical ones Made with the same specimens as Series V this is another total miss

Of five tests four were complete failures and one a partial failure This is very much worse than one should score with out right guessing It would seem that the method employed was sufficiently discredited by these findings but if we arrange the returns a little differently we must grant that the performance attained in these tests looks even worse

In Series I II and III combined, six sets of readings in all were made upon specimens of identical origin Series IV gives us three such readings and Series V and VI together give us six If there is anything at all in the electronic diagnosis the readings ought to agree fairly well within each of these three sets It is putting it very mildly indeed to say that they fail wholly to do this

For rate 57 on the samples of the first day readings run from 4 to 44, and they are quite evenly distributed through this interval They are so scattered that it is idle even to talk about averaging them the average of 4 13 21 22 23 and 44 is quite without mathematical significance Similarly rate 55 runs the gamut from 0 through 4 to 11 What would we say of a scientist in any field whatever who couldn't determine the correct reading, in degrees or volts or centimeters or grams or seconds or what you will any more accurately or consistently than this? What would we say of him if, in response to a straight yes and no proposition he gave us three yesses and three noes as these rates do when asked the sex of this subject? What would we think of him if after this showing he continued to use with apparent confidence, the method by which he had reached these extraordinary findings?

Rate 55 for the six readings of the third day is another particularly damning thing For that matter, rate 57 on this day is a most extraordinary exhibit, if offered in support of the technique under which the readings are made three answers slightly above 20, and three more slightly in excess of 30, are pretty crude. And what of rate 55 on the second day? or rate 60 for this day? or rates 42 and 60 for the final day? Isn t the answer pretty obvious? Can we possibly believe that this technique is anything more than subconsciously directed guess?

Of course, if the electronist were diagnosing a patient from one of these specimens the chances of contamination etc etc etc would be considerably greater than in our carefully conducted tests, with their elaborate ritual But in that case nothing would be said throwing question upon the results while in the present instance, the electronist will protest and protest upon the grounds indicated Just by way of letting him have his way let s turn, then, to the readings for the individual samples Surely he cannot, without losing his face entirely, claim that two tests made, in quick succession upon the very same sample, may diverge seriously and properly and without embarrassment to the Abrams claims.

On the first day specimen 1 gives readings of 22 and 44 for rate 57 0 and 11 for rate 55 0 and 6 for rate 58. Specimens 1 and 6 of the third day show an alarming variation in rate 55 Among the single isolated specimens there is even more of this sort of thing On the first day, specimen 3 gives 4 and 13 for rate 57 specimen 4 gives 14 and 24 2 and 15, male and female for the same rates specimen 6 gives five discrepancies that run all the way from 200 to 1800 per cent Though this might well set the climax, we must still direct the reader s eye to the readings of Series V and VI, with 21 matched against 32 and 34 2 against 11 3 against 23, 7 against 3—and all three of the specimens contradicting themselves on rate 49! It would certainly be fair to remark that if these rates correspond to anything in the pathology or physiology of the subject from whom the blood was taken we should hardly expect that *two* individuals taken at random would exhibit such wide discrepancies in general as do these specimens taken from the *same* person

The showing would be far worse were it not for the objectionable lowness of the readings. Were it pretended that they are at all minutely accurate this would not be so bad Readings of 0 and 1, of 1 and 2 etc can be compared easily enough if only we know that 0 means 0 and 1 means 1 and 2 means 2 But when it is understood to begin with that all that any of these readings mean is low they cannot be intelligently compared Let us see just what a little mathematical conventionalizing will do to discount this inconvenience

Where at least one of the readings for a given rate exceeds 5 we can make intelligent comparison Confining ourselves to readings from the same single specimen there are 29 such comparisons to be made from the appended tables and of these only five show reasonable agreement between figures which should be identical the other 24 diverging If we extend the comparison to cover all samples from the same subject the number of comparisons which we may make is increased to 72 and 18 of them are reasonably close while the remaining 54 are in discord Surely this is a most disreputable showing for a procedure which is claimed to be from 80 to 90 per cent right—when we are not watching and which is used by its supporters as a basis for discrediting the standard clinical diagnosis

The straight yes and no proposition of rate 49 gives us another dreadful showing Confining our attention to individual specimens fifteen independent comparisons are possible and of these five are in agreement and ten in disagreement. If we permit ourselves to compare distinct specimens from the same individual as well we get a total of 41 comparisons, of which 17 check and 24 refuse to check If frankly guessing we ought to be right on this 50-50 question exactly half the time And here where we are alleged to be doing something better than guessing we must be right considerably more than half the time—instead of which we are wrong practically two thirds of the time

Here, then is a scientific test of E. R A which cannot be repudiated without serious complications, since the doctors who collaborated with us in this series of tests are the sponsors of a well known and widely circulated report which endorses the basic claims of Dr Abrams.

The Blast Factory

(*Continued from page 386*)

to an overhead belt drive The various dry ingredients—nitrate of ammonia, nitrate of soda wood pulp cornstarch ivory nut meal chalk and sulfur for ammonia dynamite for instance — which have been previously weighed out and screened together in the proportions called for by the formula, are poured into the bowl and the wheels are driven two or three turns to level the heap down Then the nitroglycerin is slowly run in through a rubber tube from the buggy and the machines are started As the wheels revolve an inner and an outer plow attached to each keeps throwing the powder from the sides of the bowl back under the wheels so that it will be thoroughly mixed The mixture much like brown sugar in appearance, but feeling a trifle oily is the finished dynamite and it is henceforth treated with the respect due a high explosive. Every crumb thrown on the floor by the revolving wheels is carefully swept up lest it be stepped on and explode with sufficient violence to set off the whole mixing Here as in the nitrating house the machine seems to dominate The men move about quietly in their rubber soled shoes silent as if listening for the slightest irregularity in its motion the stillness and the care and precision of their movements as they tend the machine suggesting a ritual and creating a feeling almost religious When the mixing has continued for a stated time fixed by the laboratory for each kind of dynamite and measured by a sand glass the mixers are stopped and the dynamite is shovelled out with wooden shovels into wooden boxes and sent to the packing house The process of mixing straight dynamites is the same as that used for ammonia dynamites the difference being that the former contain a larger percentage of nitroglycerin and no nitrate of ammonia

At the cartridge packing house the bulk dynamite meets the paper shells which have been made in the shell house and sprayed with hot paraffin to waterproof them and a very ingenious machine packs the explosive into the shells The dynamite is dumped on an inclined conveyor which feeds it into a hopper at the top of the machine while the paper shells are fed automatically into a revolving drum beneath the hopper A battery of tamps operated by a friction drive rise and fall in the shells until the powder is packed to a uniform density As soon as one row of cartridges is packed full the drum automatically revolves bringing another row of empty shells under the tamps while the open ends of the filled shells are folded over and the finished cartridges are dropped into a trough from which the operator gathers them up to stand them on end in crates

The processes of mixing and packing gelatin dynamite differ somewhat from those employed for the types which are of a granular consistency The gelatin mixing machine consists of a bronze bowl shaped like an oval and supplied with a hot water jacket and with two paddles operated by an electric motor The nitroglycerin is run into the bowl a small percentage of nitrated cotton is added and the paddles are started The nitroglycerin is gelatinized by the nitrocellulose and this gives the dynamite plasticity and water resisting power The dry ingredients similar to those used in other types of dynamite which have been previously sieved together are next poured in and the agitation is continued until the mixture becomes uniform and reaches the proper degree of plasticity To determine this point demands the nicest judgment for while on one hand the degree of gelatinization directly affects the efficiency of the dynamite on the other science has never yet been able to fix a time and temperature for mixing which would yield a uniform product from different mixings The gelatin foreman must decide when to stop the agitation according to the look and feel of the dynamite

In the gelatin packing houses the plastic mass is fed into the hopper of the packing machine and a revolving worm in the hopper squeezes it out through multiple nipples into the paper shells held in shuttles on a turn table below

The crates of cartridges from the cartridge packing houses are transported to box packing houses and dipped into a vat of hot paraffine The cartridges are then packed by hand into wooden boxes—25 or 50 pounds net weight—which are either loaded at once into freight cars or stored in a magazine until needed for shipment.

Several carloads of dynamite are shipped from this great plant every day—some 60 000,000 pounds annually It goes into the

mines to furnish the energy for breaking down coal and for getting out the ores from which are derived iron steel copper, lead, zinc gold silver—all the metals, into the quarries where it is used to blast stone for flux in the ore furnaces, for grinding into cement and for building railroads and highways and jetties and breakwaters into great construction operations where it is employed to dig canals, excavate foundations for buildings drive tunnels through the solid rock and cut roadbeds along steep mountainsides into the cutover lands of the Northwest and the swamps of the south where it blasts ditches to drain the land or clear it of stumps so that it can be put under cultivation for all these industries and the commodities which they make possible are inseparably linked with the manufacture of dynamite

Studying Fire Risk from Sample Fires

(*Continued from page 388*)

nothing *especially new in this* But it seemed advisable to study what was going on during the period of slow crushing It *was ultimately found that at the ends and* at certain short distances from the ends moderate temperatures brought about a softened —*almost a plastic*—condition After this discovery efforts were made to devise a protective cap for the ends of wooden columns This has been carried so far that a series of tests has resulted in showing that a wooden column may be so installed as to endure the fire test for one and one half hours instead of thirty minutes In all cases in this series the column failed in the body portion and not at the ends

It will be gathered perhaps from the foregoing examples that the investigations are producing a new fund of information—useful to insurance companies owners and builders

What are called 'fire windows —that is windows capable of withstanding fire heat and water—cannot in the nature of the case be made equal to high degrees of exposure Light must pass through the glass—otherwise the window is no window at all This means also that more or less heat will go through Then the glass softens and falls out even wired glass being subject to such failure However there is such a thing as a fire window capable of affording a useful amount of protection Such windows have been developed it seems largely in consequence of experiments made by way of test The window will be exposed say to a multitude of gas burners. Early in the *test as the wired glass absorbs the great* heat, there will be a series of reports and a network of cracks will spread over the *window The advantage of the wiring* becomes clear since the wires maintain the cracked glass for a period In one of the *views is shown a wired glass window with* metal frame which has undergone nearly one hour of exposure to flames

Criticisms of Our Article "More Steam-Engine Power Without Steam"

IN the March 1924, issue of the SCIENTIFIC AMERICAN there appeared an article entitled 'More Steam Engine Power Without Steam' which attracted a good deal of attention and we are sorry to state a good deal of criticism From time to time there appear certain substitutes for water and steam for use in the usual steam boiler and engine for which elaborate claims are made In this instance, our Chemical Editor Mr Ismar Ginsberg was sent to Philadelphia for the purpose of investigating the latest of these steam substitutes Mr Ginsberg was highly impressed with what he saw together with the data supplied him by the inventors. Once we were convinced that the inventors in this instance were sincere and seemingly practical, we opened our columns to a short description of what they had done We happen to know the composition of the secret liquid but cannot make public mention of same for obvious reasons

Many have been the criticisms received with regard to this article However that from the Bureau of Standards which we quote below, is sufficiently representative to serve the *present purpose*

"It seems appropriate that the Bureau should offer some comment as requested in *your letter of April 10th* on the article More Steam Power Without Steam' appearing in the March, 1924 issue of the SCIENTIFIC AMERICAN, in view of the fact that from the manner in which the Bureau is referred to in the article many readers would infer at least a tacit endorsement of the claims of the inventor and promoter Except for this fact, the Bureau would have no occasion for official comment.

'As far as the reference to the Bureau is concerned it can be said that the statement that tests of the 'mysterious liquid' had been made is entirely incorrect. The Bureau answers thousands of miscellaneous inquiries each year, and it is quite possible that some information drawn from available data, was furnished upon request.

In reference to the article in general and the claims set forth in it, it may be said that the fact that liquids of low boiling point, such as the one which is the subject of the article, develop considerable pressure when heated to moderate temperatures in a closed vessel, has frequently misled inventors into believing that power could be developed more efficiently by the use of such liquids than by the use of steam It is, however a direct consequence of the second law of thermodynamics that efficiency in power production is promoted by the use of high temperature in the boiler, and consequently other things being equal the liquid which at *a given temperature has the lower vapor* pressure will yield the higher efficiency The development of the mercury turbine which is *mentioned* in the article involves a practical application of the facts stated above

As for the evidence given in the article that the new liquid produces power more efficiently than steam the demonstration might easily deceive the uninformed but any one at all familiar with power development would at once recognize the numerous flaws in the demonstration'

Condensed Milk

AN important report by Dr Savage and Mr Hunwicke on the manufacture condition bacteriology, and spoiling of commercial sweetened and unsweetened condensed milk has been issued by the Food Investigation Board (British) (Special Rep No 13) The changes in the condition of the milk as a result of its concentration are profound and are not merely those caused by deprivation of water *It is for example a much worse* conductor of heat than unconcentrated milk While sporing aerobic bacilli are present in *a considerable proportion of samples* decomposition and spoiling are nearly always due to non sporing bacteria particularly certain *micrococci* which either survive the preliminary pasteurization of the raw milk in the course of manufacture or after canning *are admitted to the tins* through minute leaks The sources of bacterial contamination and multiplication are mainly from the original milk from the air of the factory, and particularly from dirty pipes and apparatus

The Sky by Day

(*Continued from page 402*)

of eternal cold This is the region in which shooting stars stage their displays

But up in those regions where the last vestiges of the earth s atmosphere is dying away and that infinitude of frigid emptiness begins, there are still other phenomena to interest mankind At altitudes as high as five hundred miles are the mighty auroral arcs These restless shifting curtains, streaks and bands are the electrical effects of the heavenly stage, doubtless caused by electrons of particles projected from the sun If so they are similar to vacuum tube phenomena *Apparently they are related to the* sun spots and to terrestrial magnetism The magnificent splendor of the aurora is a fitting ending to the day, for the beauty and scientific interest of the day-sky demands a splendid benediction

The stars come out, and we pick out Saturn and Jupiter and others of our family They are receiving light from our sun which *is far below the horizon* We turn toward Polaris and see in our imagination the cycle of the heavens We pick up our telescope and look at the other *suns* and see many stellar bodies come into being which were invisible to our unaided eyes We wonder how *many* of these bodies still remain behind the veil as yet unpenetrated by the greatest instruments. We wonder if space is infinite and we form a conception of infinite space I wonder if we do or if we can conceive this infinity!

We leave the question undecided. We know at least that another day is coming and with it is another procession of sky interests ever-changing and ever-interesting full of unanswered questions but each when answered revealing others still unanswered.

Fighting the Bed Bug

(Continued from page 392)

water, powder and liquids. But cleanliness and chemicals are only partly effective and necessitate a constant, wearisome battle.

People are now thinking about this pest in a bigger way. The bed bug is really a community problem. Given the necessary public opinion there is little doubt that communities would take steps to vanish the bed bug from their borders, just as community pride has vanished pests like the cattle tick. When public opinion grows up to this problem, then the sanitarian will begin extermination in a large scale way with poison gas and modern apparatus for using it.

Hydrocyanic acid gas is the ultimate weapon. Made by mixing the two deadly poisons cyanide of potassium and sulfuric acid it is so penetrating and deadly that the Department of Health of New York City now prohibits its use except under strict regulations. In the fumigation of homes, business premises and ships people are occasionally killed accidentally—occupants not known to be in the infested area or sometimes adjoining premises and even exterminators caught off guard. It is so quick in its penetration and action that experts applying it must wear gas masks. Its danger is increased by the fact that it has no odor. Lately, Washington experimenters have mixed tear gas with hydrocyanic so that it gives warning but even in this form it is extremely hazardous.

Under the New York regulations hydrocyanic can be applied only by qualified experts approved by the Board of Health and a separate permit must be obtained in each case where it is to be used. Great care must be taken to see that not only infected premises are vacant but in apartment buildings the premises above below and on each side. Warning signs must be posted at every entrance and watchmen as well, the latter remaining until the work is done.

Something like $3,000,000 yearly is spent in New York City alone to keep better-class apartments and houses free of bed bugs. More than one thousand professional exterminators are at work all the time. In most cases for property owners who engage them by the year. Whenever apartments are vacated the exterminator treats them and should the pest be brought in by new tenants does his work again. Yet despite this care in a few sections where residence property values are highest not even those sections are permanently rid of the pest because it is constantly being brought in from other sections. A novel fact about the industry is that professional exterminators do a good deal of charity work like physicians—Mr. Sameth's organization has under taken gratis to keep several day nurseries free of insect pests to which they are peculiarly susceptible.

The bed bug has a money value of a negative kind. It is economical not to have him around. For in property free of this pest, the outlay for repairing, repapering, repainting and renovating is generally reduced. The architect nowadays gives serious thought to economy of operation in his building whether it be an office structure, a great hotel, an apartment house or residence. The professional exterminator advises the architect to take the bed bug into account when planning apartments and homes, eliminating every possible refuge and breeding place in walls, molding, wainscoting, closets, plumbing and the like, and also providing a steel or concrete chamber on the roof of every apartment house and hotel, fire-proof and air-proof, a death chamber to which bedding, furniture, luggage or anything else can be taken for treatment with hydrocyanic gas without disturbing occupants.

Vermin are often the first tenants of a new building. The tearing down of the old building on the site displaces rats and mice who seek homes in the new building as soon as they can establish themselves. Insects of various kinds, including the bed bug, are brought in with building materials from the mills and warehouses. Workmen likewise bring in pests. On this account the present day exterminator takes contracts for his services while the building is being erected, making inspection before the floors are laid and after they are down, when the plastering is done and at other stages of the work.

"A real beginning in the extermination of the bed bug and other household pests will be made when communities pass ordinances compelling it," says Mr. Sameth. More than once public opinion has been brought to the point where the people of a community have seen the wisdom of tackling this problem in a big way, but in practically every case the attack was made by appropriating public money for an educational "drive" with the outcome that funds were wasted, some being spent for extermination work along ineffective lines. An extermination ordinance would compel all property owners to bear the expense of eradication. They would thus have reason to make sure that they got value for their money and sources of reinfection being cleaned up there would be permanent benefits. Along with such an ordinance should go some system for examining and licensing exterminators instead of simply hampering them with regulations that increase the cost of doing the work and put it beyond the reach of many householders and property owners.

Many ways have been devised for fighting rats, ranging from catching them alive with the aid of ferrets, as the old fashioned rat catcher does, to the upsetting of sex balance, a method by which the animals are caught alive, the females killed and the male turned loose to fight each other and reduce breeding. Poisons, traps, electrocuting devices and even fly paper that catches rats with bird lime are in use. Mr. Sameth declares that they are all good with one shortcoming—that they seldom destroy rats and mice as fast as they can breed. The latest weapon is bacterial. Pasteur isolated the germ of a disease fatal to rodents but harmless to other animals and human beings. This was used with some success, being spread by baits that communicate the disease to the rats who ate them, they in turn infecting others. Bacteria generally require something approximating blood temperature to thrive. As originally used on baits they lost their virulence, being affected by lower temperatures and atmospheric conditions. Mr. Sameth has devised a new procedure by which the bacteria are kept vigorous at the proper cultural temperature and injected into live rats which are then turned loose. Inoculated in this way the animals are carriers of the disease in its most virulent form, so that one hundred and fifty infected rats turned loose at strategical points in a large railway terminal where rat damage amounted to $20,000 a year resulted in reducing the damage to $5 a year and the picking up of more than four thousand dead rats over a five months period. Along with the rats a plague of fleas disappeared, for the flea in most of our large cities is almost invariably a warning that rats are growing beyond bounds. When both rats and fleas were gone, there was a brief plague of mice which are generally kept down by rats and increase when the latter disappear. In comparison with a rat plague, however, mice bring no great difficulties to the exterminator. They are eradicated by innoculation.

The Story of Steel—VI

(Continued from page 396)

started by the ore reactions. The heat is then worked until the carbon in the bath is approximately that required in finished steel. Tests are taken of the heat and broken, the fracture is examined and expert melters read the carbon.

When the heat is considered ready a steel bar is thrust through the hole in one of the doors and the retaining plug in the rear of the furnace is knocked out allowing the steel to run through a trough into a ladle which has already been heated by gas to dry out all moisture in the lining. The steel is then purified by the addition of certain deoxidizers such as ferro silicon and manganese, the greater part of the manganese remaining in the steel in order to meet the desired specifications. The necessary carbon is added either in the form of finely granulated coal or of molten spiegeleisen—a high manganese iron containing sufficient carbon and manganese to give the desired results. The slag being lighter than the steel floats on the surface and much of the slag runs over the side of the ladle into pits or boxes kept for that purpose.

At a signal from the melter a massive crane, electrically operated, is moved in front of the furnace, drops its arms under the lugs of the ladle, lifts it and carries the mass of molten steel weighing often as much as 100 tons to the pouring platform, where the retaining plug or stopper is lifted up and the steel through this aperture in the bottom of the ladle, pours into cast iron ingot molds, these ingots varying in size and weight, according to the product into which they are to be rolled. In an average size heat of 60 to 75 tons, the ingots will weigh approximately three and one half tons each and be about 20 inches by 22 inches at the bottom, 6 feet or slightly more in length and slightly tapering towards the top.

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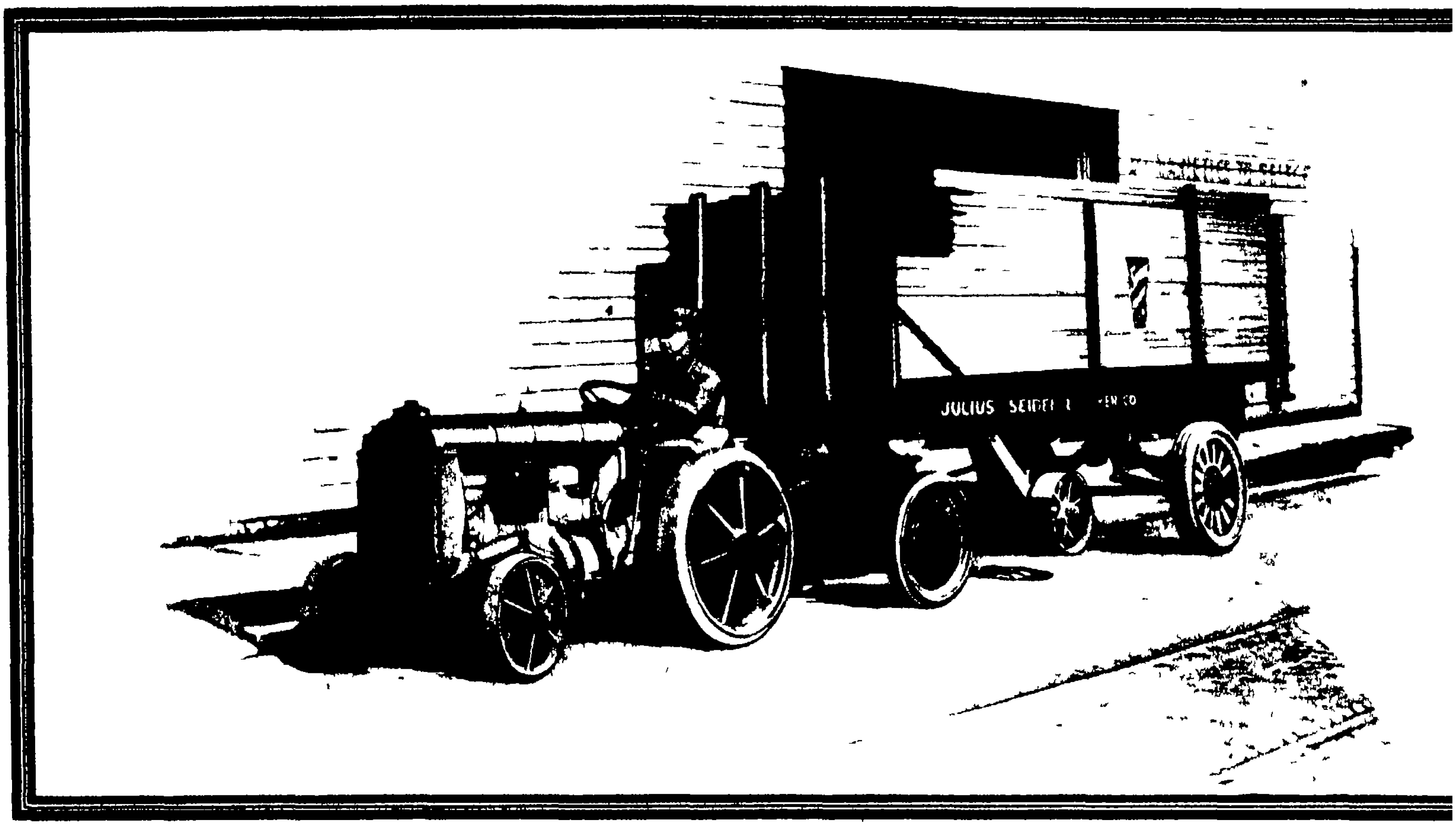
Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place Each article is therefore entered where it is believed it will be most easily found. In every case the general subject should be sought rather than the supposed specific title of an article the article may not be indexed under its specific title at all but may be entered under a statement of what it is about so that it may the more readily be found by one seeking reference to its subject matter We call special attention to the classifications Household Appliances Machines and Machine Tools Machines for Special Purposes Tools etc under which many items will be found whose location otherwise would be very puzzling These groups may be examined item by item for a doubtful entry with much greater ease than can the entire alphabet The short notes comprising the columns of text on the advertising pages are not indexed separately but only under their column headings The asterisk (*) indicates that the article in question is illustrated



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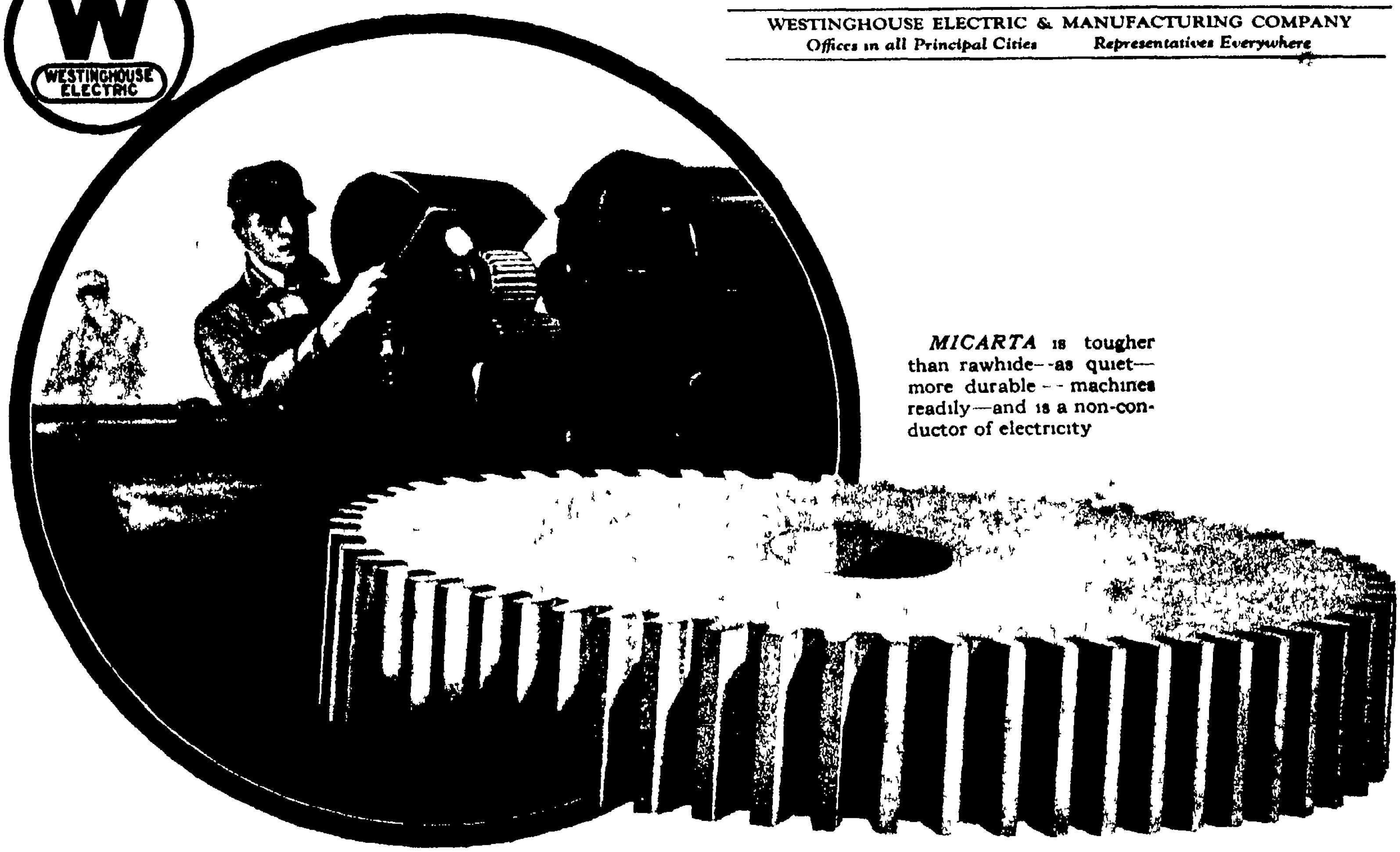

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